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Bridge Strengthening by Welding Under Traffic

The Use of Vibration in Concrete Placement

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Electrified Rail Terminal in Downtown St. Louis

Illinois Terminal Railroad System builds elevated and subway line from its McKinley Bridge over the Mississippi to a large freight and passenger terminal—Project transforms a large section in downtown St. Louis

TERMINAL-RAILROAD freight and passenger facilities in St. Louis, so far as traffic to and from Central Illinois is concerned, have been greatly augmented by an extensive improvement program inaugurated by the Illinois Terminal Railroad System. Although only partly complete, the work has transformed a section of downtown St. Louis from a slum residential and small-business district to a high-class modern manufacturing district.

The improvements completed consist of a 2½-mile double-track electrified line, partly elevated and partly subway, running from the company's McKinley Bridge over the Mississippi River to a terminal on Twelfth Boulevard between Washington and Delmar Aves. Over the terminal there has been built a seven-story warehouse structure known as the Central Terminal Building. Twelfth Blvd. has been widened from 50 to 98 ft. for a distance of six blocks immediately north of the terminal where it comprises the roof of the new subway. Planned for future construction, with steelwork now erected to street level, is the North American Building, a modern office structure adjoining the Central Terminal Building on the south. Underneath this building the passenger lines will terminate in a new station; at present, temporary passenger facilities are provided in the freight area below the Central Terminal Building.

New businesses, attracted by the shipping facilities, have located along Twelfth Blvd., where private sidings are available underground. An example is the Globe-Democrat Building. Another newspaper, the *St. Louis Star*, is building on air rights over the tracks north of Delmar Ave.; some of the steel frame is already in place, and it is contemplated that the new plant will be ready for occupancy about March 1, 1934. With the completion of this building and the North American Building, four block fronts on the east side of Twelfth Blvd. will have been completely rebuilt.

The Illinois Terminal Railroad System comprises a group of seven companies serving Central Illinois. Some of the roads are steam and some electric. The company owns the McKinley Bridge, 600 miles of main line, and

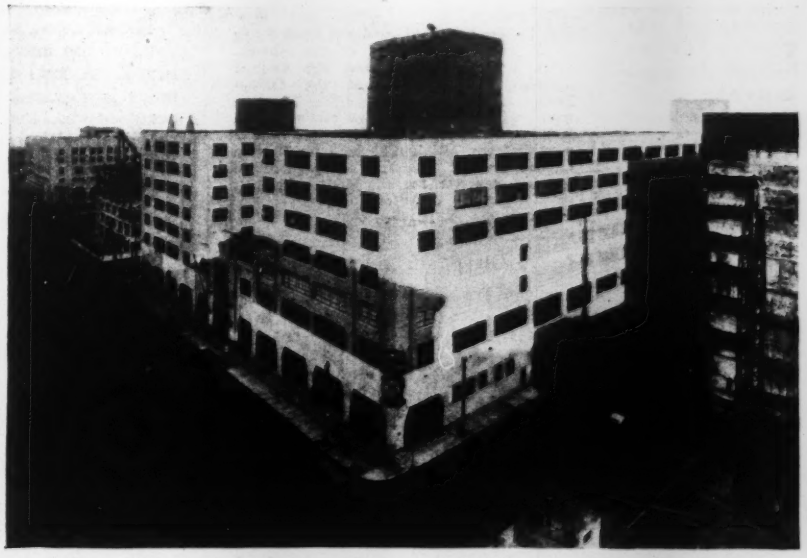


Fig. 1—Terminal development transforms section of downtown St. Louis. At the right is the uncompleted North American Building; next, in order down 12th Blvd., are the Central Terminal Building, the St. Louis Star Building (under construction) and the Globe-Democrat Building. Subway tracks under 12th Blvd. pass beneath the Star Building into the lowest level of the Central Terminal Building.

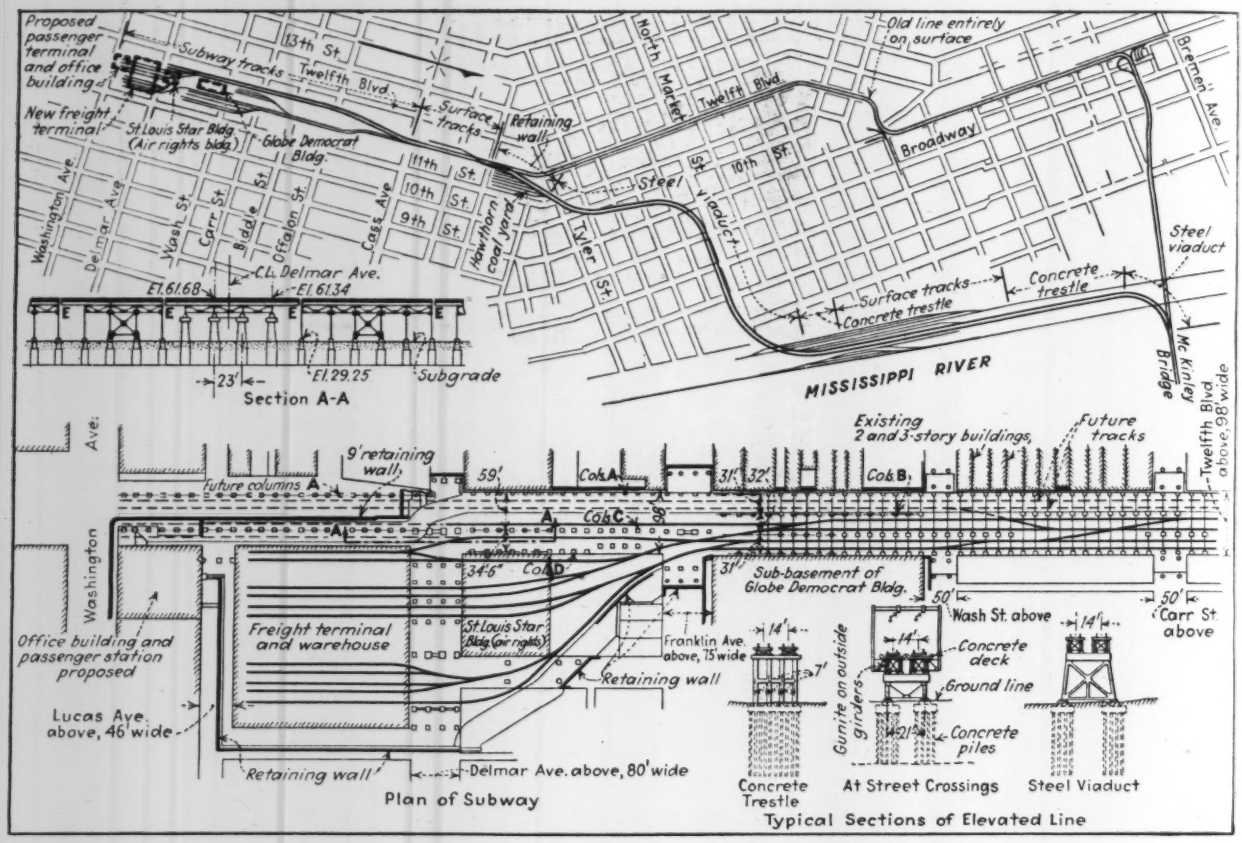


Fig. 2—New rail line is 2½ miles long, partly elevated and partly subway. Plan of subway portion shows terminal trackage.

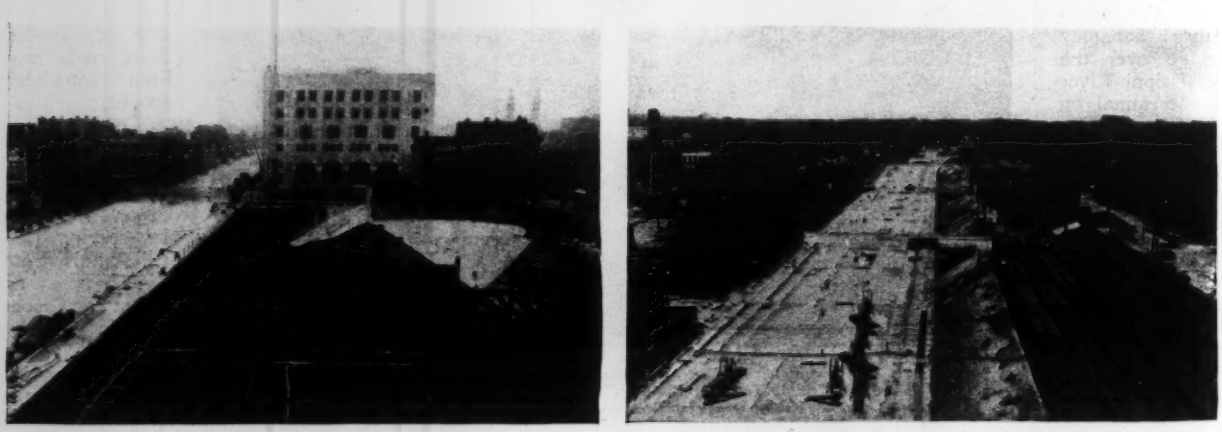
has connections with all transcontinental railroads. The region served is important industrially, containing not only manufacturing plants but many mines.

The McKinley Bridge, built in 1910, afforded the company its first access to St. Louis. But from the bridge the tracks had to follow a circuitous surface route, congested with vehicular traffic to the company terminal. In the early years the business handled was primarily passenger, but freight business grew so rapidly that in 1929 the company embarked upon the present electric terminal improvement and warehouse project, and at the same time made provisions for more expeditious handling of passengers in a new station. An essential part of the new project was the elevated and subway route (2.58 miles long) connecting the McKinley Bridge with the new terminal. By eliminating 29 grade-crossings this new route has overcome the serious difficulties attendant on the old surface-route operations. About half of this new route—that is, the elevated portion—was put in operation on July 4, 1931. The subway portion and the terminal were not completed until 1933.

Fig. 3—Twelfth Blvd. widened from 50 to 98 ft. comprises the roof of the subway. Left: Looking north from the Central Terminal Building toward the Globe-Democrat Building, with the Star Building steel in foreground. Note retaining-wall forms and paved slope around track-entrance area. Right: Looking north from Globe-Democrat Building, subsequent to pouring concrete for the deck with belt conveyors.

Elevated route

The elevated, subway and surface sections of the new route are indicated in Fig. 2. A total of 1.61 miles of the 2.58 miles is elevated. The subway portion occupies six blocks at the south end of the line and comprises the entrance to the terminal. Two short sections are on the surface (or on fill held by retain-



ing walls), but the grade-crossings involved are relatively unimportant so far as possible delays from vehicular traffic are concerned.

The new line leaves the McKinley Bridge on a 12-deg. 30-min. curve to the south, whereas the old line continued west on tangent. The turnout was effected by installing a new 250-ft. span truss alongside the two existing trusses of the bridge approach. The outer end of this new truss was supported on the west river pier of the bridge (Fig. 5), but for the inner end an extension to the existing land pier had to be built. This was provided for by sinking a pneumatic concrete caisson 15 ft. in diameter alongside the existing pier, building up a shaft to the required elevation and tying it to the existing pier with a 66-in. concrete beam that supported the new bridge seat. The total height of the new pier from rock to bridge seat is 87½ ft.

All elevated portions of the line are on private right-of-way. Typical sections are shown in Fig. 2. In general, steel viaduct is used where high bents are required, where the line passes over streets or where erection requirements made it easier to use steel than concrete. Only about 1,000 ft. of the total length of elevated structure consists of concrete bents. Most of the foundations rest on concrete piles. All superstructure girders and trusses are steel. Except at grade-crossings, where a ballasted concrete deck is used, the track is carried on timber ties resting directly on the steelwork. Rails of 100-lb. section are used throughout. Construction of the elevated line was preceded by the extensive demolition of three- and four-story brick tenements and obsolete business buildings.

Subway route

The portal of the subway section of the line is located near O'Fallon St., about 2,200 ft. north of the terminal. This section runs beneath Twelfth Blvd. and was constructed in open cut, since it was possible to close off the street. Twelfth Blvd. in this section was originally 50 ft. wide, and the plans required increasing this to 98 ft. between building lines. All of the increased width was obtained on the east side of the street, which was occupied by three- and four-story brick tenements.

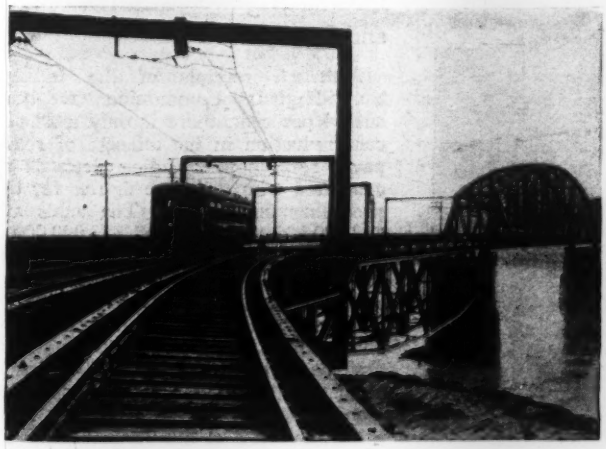
Fig. 4—Widening out the subway cut in 12th Blvd. so as to encompass the whole terminal area, and pouring concrete for subway footings and retaining walls. Structural-steel portion of Central Terminal Building is complete; above this elevation reinforced concrete was used.

The 98-ft. width of subway is planned for six tracks, although only the three on the east side were required initially. This made it possible to confine excavation to the east half of the cut. The west half of the subway has been left for future excavation as needed. On the east side of the cut it was possible to leave a sloped bank along most of the route, for, with the exception of the new Globe-Democrat and Star buildings, no structures have yet been built on this side.

The material excavated was a sandy clay that could be easily removed with power shovels and trucks. Including the terminal site, about 600,000 cu.yd. of excavation was removed. It will be noted from Figs. 2 and 4 that south of the Globe-Democrat Building the cut widens out to about 300 ft., to accommodate the terminal tracks. In this area some retaining walls were required and the slope was paved, but elsewhere no protection was provided for the sides of the cut.

Street deck structure

The deck structure that carries Twelfth Blvd. consists of steel bents on concrete footings carried to solid rock. Four-column bents are required to span the 98-ft. cut. However, except in front of the Globe-Democrat Building, the second line of columns from the west side has been omitted to permit installation of cross-overs to tracks along the west side. The bents are spaced from



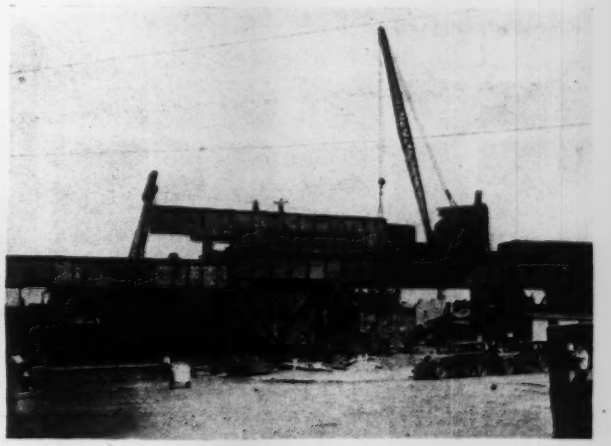
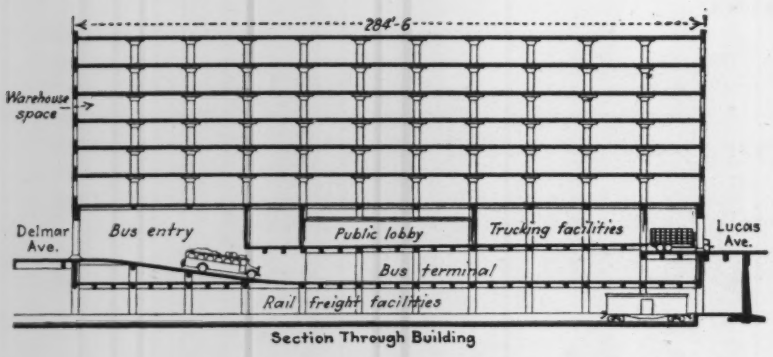
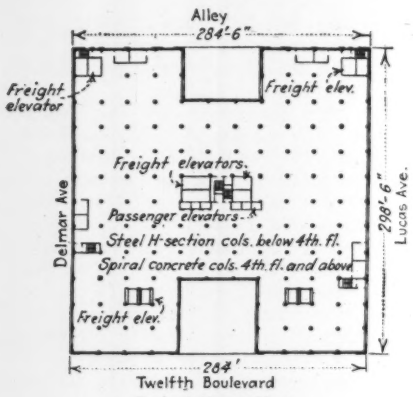


Fig. 5—Two-thirds of the new line is elevated. Left: Curve at beginning of line at McKinley Bridge over the Mississippi River. Right: Steel erection at one of the street-crossings.





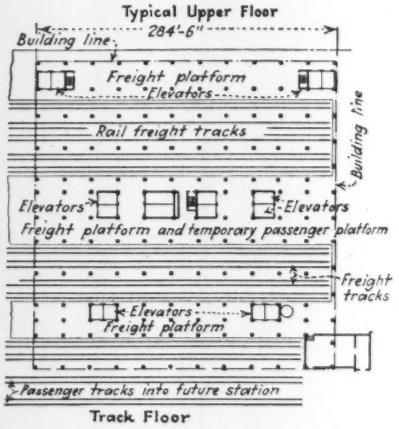


Fig. 6—Below ground the Central Terminal Building has rail freight and passenger facilities as well as bus passenger facilities. Above ground it is a warehouse suitable for storage or light manufacturing.

20 to 23 ft. apart, and are about 30 ft. high. In general, every second pair of bents is braced longitudinally. At every fourth bent an expansion joint, completely breaking the structure, is provided. Both girders and trusses are used to support the street deck. At cross-streets the steel bents are omitted and the concrete piers carried up to the bottom of the trusses for better stability against the traction forces on the streets.

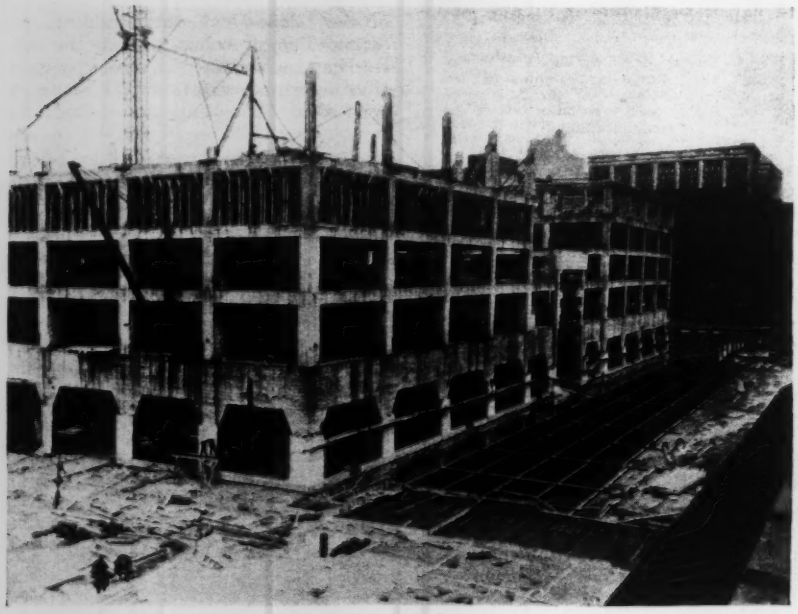
Terminal facilities

The ultimate plan is for the freight tracks to terminate between Lucas and Delmar Aves. (as they do now in the basement of the Central Terminal Building), while the passenger tracks will be extended across Lucas Ave. into the new passenger station in the basement of the proposed North American Building.

The terminal building was projected as a warehousing, storage, small manufacturing and reshipping unit to be served by the railroad tracks in the basement. It occupies a site about 300x 285 ft. in plan and is seven stories high, with provision for adding five more stories. In its present state it provides 634,000 sq.ft. of floor space and has a volume of 11,285,000 cu.ft. The street floor, planned for shops, is now occupied by passenger ticket offices and waiting rooms, and the upper floors are available for storage and manufacturing operations. In a mezzanine floor below the street level is a large bus terminal. Rail-passenger facilities are provided on the central freight platform in the basement of the building.

The building is of reinforced-concrete construction with steel-cored columns up to the fourth floor and spiral reinforced columns above that level. It is faced with brick and stone. The first four floors are designed for 250 lb. per sq.ft. live load, with 150 lb. per sq.ft. on the upper floors; each floor has a useful area of about 75,000 sq.ft. Truck-loading platforms are provided at street level, and freight elevators serve all floors and the basement railway terminal. There are twelve of these freight elevators with capacities ranging from 7,500 to 12,000 lb. Six high-speed passenger elevators serve all floors from the street level upward. The first-floor ceiling height is 17½ ft.; other floors are 11 ft. 9 in.

Fig. 7—Central Terminal Building under construction. Upper stories are of reinforced concrete. Rail and bus terminal areas below ground are framed with structural steel.



Indiana Highway Mileage and Receipts

Although receipts of the Indiana State Highway Commission have been cut 44 per cent, there is only a 28 per cent reduction in the mileage of roads paved for the year ending Sept. 30 as compared with the same figures for the preceding fiscal year. The sums are $13,000,000 this year and $23,000,000 a year ago. Mileages are 283 as compared with 390 miles last season. The reduction is due to the diversion of one-half the gasoline tax and license fees to the counties and municipalities. The Indiana system embraces 8,600 miles of road, and more than 9,000 people are employed in maintenance and in handling the work of the department.

Shaft-Sinking by Caissons in Ancient Egypt

Recent explorations disclose use of both timber and stone caissons for soft-ground shaft construction some 2,000 years before the Christian era

CAISSONS were used successfully in shaft-sinking in the twentieth century B.C., according to discoveries made in recent Egyptian explorations by the Metropolitan Museum of Art of New York City. The shafts were through gravel conglomerate and sand some 23 ft. deep overlaying limestone rock and down into the rock (in one case to a total depth of about 66 ft.) to passages leading to burial chambers excavated in the limestone. Three caisson-sunk shafts were explored. For one a timber caisson had been used, but for the other two the four-sided caisson boxes had been hollowed out of rectangular blocks of stone. Only vestiges of the timber caisson remained, but the stone caissons were intact and still supporting the brick shaft lining as they had four millenniums ago when the royal engineering staff had completed the two pyramids of Se'n-Wosret I (2,000 B.C.) and the tombs of the royal household.

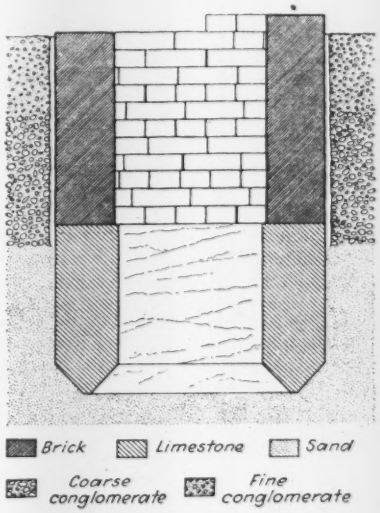
The report of the museum explorations lacks dimensions of the caissons, but the graphic descriptions of their discovery and the probable manner of using them, by Ambrose Lansing of the expedition staff, is a document of engineering interest. Referring to the pyramid explorations Mr. Lansing writes:

"In the course of our clearing we came upon a depression in the court which extended through the upper stratum into the sand level. The fill was not clean, and we continued to remove it until we came upon brick walls forming an irregular rectangle. By building a rough wall on this we succeeded in blocking the flow of the sand and were able to clear the space between the walls. As we went down they became more regular and showed themselves to be the typical brick lining of the mouth of a pit; but they extended to an unprecedented depth, and we could not make out how it had been possible to build them up through a layer of nearly seven meters of loose sand. The explanation came when we got to the bottom of the walls. We found that they had been built from the top down instead of from the bottom up, incredible as this may seem.

"There must have been a master mind among the engineers engaged in the building of the pyramid. A problem was solved then by an invention which is still in use and which has made possible many of the huge erections of the present day—the caisson. Of course the principle may have been used before this period, but this application of it, so far as we know, is the earliest yet discovered.

"The Egyptians set about their task somewhat in the following manner: Having determined the place and the size of the pit, they cut through the hard upper stratum to the sand level, making the cutting sufficiently large to allow for a brick lining. A block of limestone was then cut to the same dimensions as the pit and to an appropriate height. This was pierced with a vertical hole and hollowed out to the size which the intended shaft would have after the brick lining was laid up. The hollow block was then lowered into the pit until it rested on the sand. On the rim of the caisson was built a brick wall of the same thickness as its top surface, with smooth faces both on the inner and on the outer side. When this wall had been constructed to the level of the ground, or perhaps a little higher, the digging of the pit was recommenced. As each basktful of sand was removed, the stone caisson, and with it the brick wall which rested on it, settled slightly. The sand had to be removed with care from under all four sides equally, in order to prevent the stone from tilting. Gradually the stone sank through the sand, and as it sank courses of brickwork were added to the wall above. Eventually the hollow block rested on the limestone which formed the bedrock below the sand stratum, and the brick walls extended from it to the surface of the ground. From this point on all was plain sailing. The pit was cut on down through the limestone with the same length and breadth as the hole in the caisson stone until the desired depth had been reached.

"What previous experience and experimentation had been necessary before this feat was accomplished so successfully it is impossible now to know. The bottom side of the stone had been beveled nearly to an edge, a refinement which indicates that difficulty had been encountered in causing a flat-bottomed caisson stone to sink through the sand. In an earlier attempt the pressure of the same must have pushed in the brick walls, for that possibility had been guarded against in the caisson under discussion. Traces were left of a rectangular socket at each of the four corners of the caisson stone, the upper part of the hole through the stone having been left roughly circular instead of square, as it was below, in order to allow for these sockets. Into them beams of wood must have been set, extending upward and forming the support for planking, against which the walls were built and which helped to resist the pressure of the sand. At this period the Egyptians had long known the principle of the arch and might have employed it here to resist the pressure by making the upper part of the pit circular; but presumably this would have been too radical a departure from the age-old custom of the rectangular burial shaft."



Stone caisson used in sinking shaft leading to underground burial chamber at the pyramids of Se'n-Wosret I, who reigned in Egypt 2,000 B.C.

Exploration of the other two shafts brought out no additional information on the caisson structures or operations. Acknowledgment is made to Section II of the *Bulletin of the Metropolitan Museum of Art*, New York, April, 1933, for the information and quotation composing this article.

Low Water in the Great Lakes

Reports from the Canadian Hydrographic Service indicate that except for Lake Superior, where the water level is regulated by control works at the head of the St. Mary's River, water levels in the Great Lakes are abnormally low. The level of Lake Superior is 1.48 ft. higher than the lowest October record since 1860; Lake Huron is 0.03 ft. lower than the lowest previous record for October and 2.99 ft. lower than the October average for the last 72 years; Lake Erie is at the lowest previous October record; and Lake Ontario is 0.21 in. higher than the previous October low record. In Montreal Harbor the water is 0.47 ft. below the lowest previous record for October, and 3.73 ft. lower than the average stage for October for the last 73 years.

Chemical Sewage-Treatment Methods Reviewed and Appraised

Chemical precipitation yields an effluent that is superior to that of plain sedimentation but inferior to the effluent from the activated-sludge process

CHEMICAL coagulation in sewage treatment has a field of usefulness intermediate between plain settling and complete biological treatment, according to the conclusions reached by F. W. Mohlman, Sanitary District of Chicago, in his paper entitled "Recent Advances in the Chemical Treatment of Sewage," presented at the meeting of the Central States Sewage Works Association on Oct. 12, at Indianapolis, Ind. The following article is an abstract of the material presented in that paper.

The great interest shown from 1920 to 1930 in biological processes of sewage treatment has been transferred during the past two or three years to methods of chemical treatment of sewage and the use of chemicals for the treatment and disposal of sludge. During the past ten or fifteen years mechanical equipment has been introduced into sewage-treatment practice in this country on an extensive scale, and this, together with the promotion of the sale of chemicals, has led to renewed interest in chemical coagulation.

Chemical processes now engaging the active interest of sanitary engineers include the use of chemical coagulants, the introduction of insoluble solids to the sewage and the use of materials for removing dissolved organic matter. Coagulants include ferric chloride and sulphate, ferrous sulphate, lime, chlorine, alum, sodium aluminate and copper sulphate. Under the classification of insoluble solids come paper pulp, marl, cement dust, returned sludge and ground charred sludge. The filtration of clarified sewage through zeolite for the removal of ammonia and other soluble substances is apparently new in sewage treatment, although zeolite has been used for many years for removal of ammonia from distilled water or other liquids in the laboratory. The use of chlorine to fix or precipitate organic matter may also be considered as a new development, although chlorine was suggested many years ago as an oxidizing agent. These processes can also be classified into five groups, according to the type of coagulation, as follows:

Ferric hydroxide plus zeolite—Guggenheim.

Ferric hydroxide plus insoluble solids—Laughlin, Lewis, Travers, Putnam.

Ferric or aluminum hydroxide plus chlorine—Diamond Alkali, Stevenson, Streander, Scott-Darcey, Cabrera.

Calcium carbonate plus magnesium hydroxide — Landreth, Miller-Koller.

Paper-pulp filtration—Wright.

A study of the published and unpublished results of most of the processes reveals that the degree of purification attainable by practically all of them lies between that obtainable by settling and that by activated-sludge treatment. Based on the results available to the writer, only the Guggenheim effluent (treatment comprising lime-and-iron coagulation followed by zeolite filtration) approaches or equals the degree of treatment obtained by the activated-sludge plants at Chicago, Milwaukee or Indianapolis. Coagulation and settling, with or without added materials, gives a reduction of B.O.D. ranging from 60 to 75 per cent, based on sewage of average strength; chlorination may raise this by 5 per cent. Suspended-matter removals vary from 75 to 95 per cent, the higher removal being reached where filters are used. The bacterial efficiency is usually excellent when sufficient chlorine is used or when caustic alkalinity is present.

CHEMICAL SEWAGE-TREATMENT PROCESSES OPERATED IN RECENT YEARS

Name of Process	Where Operated	Approximate Volume Treated, Gal./24 Hr.	Chemicals and Solids Used
Laughlin	Dearborn, Mich.		$FeCl_3$ or $Fe_2(SO_4)_3$, CaO,
	Coney Island, N. Y.	3,000,000	paper pulp, Cl_2
Guggenheim	Dyckman St., N. Y.	2,500	$Fe_2(SO_4)_3$, CaO, zeolite
	Chicago	25,000	NaCl for zeolite, H_2SO_4 for ash
Lewis	Atlanta, Ga.	500,000	$FeCl_3$, CaO, cement dust, $FeSO_4$
Travers	Ashland, Ohio	500,000	$FeSO_4$, CaO, marl $Al_2(SO_4)_3$
Diamond Alkali Co.	Cleveland, Ohio	50,000	Cl_2, $FeCl_3$ and/or CaO
Streander	Philadelphia	30,000	$FeSO_4$, CaO, air
Stevenson	Palo Alto, Calif.	36,000	$FeCl_3$, Cl_2
Landreth	Winston-Salem, N. C.	6,000,000	CaO (electric current)
Wright	Rockville Centre, N. Y.	3,000,000	Paper pulp (CaO)
Cabrera	Wilmington, Del.	60,000	$Al_2(SO_4)_3$, Cl_2
Miller-Koller	Elmhurst, Ill.	130,000	CaO, $CuSO_4$, Na_2CO_3, $Na_2Al_2O_4$, Cl_2
Putnam	Valparaiso, Ind.	25,000	$FeCl_3$, CaO, charted sludge
Scott-Darcey	Oklahoma City, Okla.	5,000,000	Fe, Cl_2

The average removals of B.O.D. for 1930, 1931 and 1932 for the activated-sludge plants at Milwaukee, Chicago and Indianapolis were 95, 92.1 and 91.7, respectively. The removal of suspended solids amounted to 93, 90.1 and 89.6 per cent, respectively.

A few results are available to show the reduction of B.O.D. and suspended solids by several chemical processes as follows:

Laughlin—Operation on raw sewage at Dearborn for 26 days, as listed by Zack, with a flow of 1.11 m.g.d., shows 91 per cent reduction of suspended solids and 66 per cent reduction of the five-day B.O.D. in the unchlorinated effluent. Tests over eleven days at an experimental installation at Coney Island, treating 12,800 gal. per day, resulted in a reduction of 84 per cent of the suspended solids and 69 per cent of the B.O.D. (unchlorinated). Chlorination at the rate of 62 lb. per m.g. increased the suspended-solids reduction to 92 per cent and the B.O.D. reduction to 79 per cent.

Guggenheim—Results at the Chicago experimental plant have not as yet been summarized, but the reduction of suspended solids will average around 95 per cent and of B.O.D. around 90 per cent, on a flow of 25,000 gal. per day. Results at Dyckman St. in New York were reported by Gleason and Loonam to show 99.5 per cent reduction of suspended solids and 96.7 per cent reduction of B.O.D. on a flow of 2,500 gal. per day.

Lewis—Operation at Atlanta for seven days at maximum efficiency showed a reduction of 76 per cent of the suspended solids and 77 per cent of the five-day B.O.D. The amount treated was about 500,000 gal. per day.

Travers—Tests recently made at Ashland, Ohio, over a period of twelve days, with an average flow of 500,000 gal. per day, gave about 85 per cent reduction of suspended solids and 50 per cent reduction of B.O.D.

Streander—It is claimed that this process will give 75 per cent reduction of the B.O.D. and that the effluent is "clear and sparkling." The coagulated settled effluent is passed through a sand filter.

Stevenson—It has been stated that the experiments at Palo Alto indicated that "It will be possible with this type of treatment to effect a removal of 95 per cent of the suspended solids and at least 95 per cent reduction of B.O.D." Chemicals for this degree of treatment were estimated at 250 lb. chlorine and 200 lb. ferric chloride per m.g. Further data in more detail should be submitted to confirm these hopes.

Landreth — Although the Winston-Salem plant has been in operation for seven years, little information of authoritative character is available concerning the removals of B.O.D. and suspended solids. Thrasher in 1929 reported a reduction of 88 per cent of

the B.O.D. and 87 per cent of the suspended solids, based upon a so-called "typical analysis" representative of three years' operation. Earlier tests of the Landreth process were reported at Allentown, Pa., in 1926. The process was abandoned then, and a new Imhoff tank trickling filter plant was installed and put into operation in 1929.

As an indication of the possibilities in the use of lime to the point of caustic alkalinity, as a precipitant of sewage, experimental tests were made by the Sanitary District of Chicago in 1923. The reduction of five-day B.O.D. in eleven series of tests at the 39th St. laboratory averaged 66 per cent, and in twelve series of tests at the Des Plaines treatment-works laboratory averaged 72 per cent.

Cabrera—There has been claimed an 89 per cent reduction of suspended solids and a 78 per cent reduction of B.O.D. for this process. No detailed results have been published.

Other Chemical Processes — Results obtained by the Diamond Alkali Co. and the Wright processes have not been reported. It is doubtful whether any representative B.O.D. results are available for the Miller-Koller and Putnam processes. The work by Scott is apparently on an ample scale, and the results will be of interest when available.

Comparative results indicate that the recent data on chemical processes are as yet meager and somewhat unconvincing, as compared with the well-demonstrated efficiency of the activated-sludge process. The conclusion that chemical treatment processes, with the exception of the Guggenheim process, do not equal the degree of treatment of the activated-sludge process seems to be reasonable and supported by the facts now available.

For the final evaluation of chemical precipitation processes of sewage treatment, many factors require study under careful supervision on a large scale. Among these are the accumulation of operating results and costs and the perfection of chemical control and sludge-disposal methods. Chemical coagulation undoubtedly has a field of usefulness intermediate between plain settling and complete biological treatment if the problems of control, cost and sludge disposal can be solved by large-scale operation.

Reducing the Toxicity of Cyanide Wastes

Toxicity of cyanide wastes produced by plating works may be reduced by simple chemical treatment

By E. F. Eldridge
Engineering Experiment Station, Michigan State College, East Lansing, Mich.

FEW industrial wastes are more hazardous than those containing cyanides produced as a result of the plating of metal parts. Many of the solutions used in industrial plants for cleaning and plating contain some form of the metallic cyanides, and the disposal of the washings and waste solutions from these plating rooms is often difficult and dangerous. It is the purpose of this article to point out two methods studied by the writer for rendering these wastes non-toxic.

Simple cyanides exert a toxic action on living organisms by reducing or eliminating the utilization of oxygen in a manner similar to asphyxiation. The action is very rapid, fatal results being produced by extremely minute quantities of the chemical. Investigation by Dr. Carl L. Hubbs of the Institute of Fisheries Research, University of Michigan, shows that most small species of fish are killed in sodium cyanide solutions much weaker than 1 p.p.m.

Cyanide-plating and cleaning solutions are made up in vats. Once made up, these solutions are seldom discarded, but are kept in condition by a further addition of the chemicals as they are removed in the process of plating. After the process is complete, the parts are removed and rinsed in a vat through which a constant flow of water is maintained. This rinse water and the spillage and drippings on the floor constitute the continuous source of cyanide wastes from a plating room. An analysis of this waste from several plants has shown that it will vary between 100 and 500 p.p.m. cyanide as KCN. The volume of this waste from a fairly large room will average about 10,000 gal. daily. While occasionally a vat of solution will become contaminated and must be discarded, to dump such a quantity of cyanide into a stream usually results in the killing of fish and in some cases, cattle and other animals.

The studies made at this station have shown that two methods can be satisfactorily used for reducing the toxicity of the cyanide wastes. These methods are (1) decomposition by acid, followed by aeration; and (2) oxidation by potassium permanganate.

In the first method the cyanides are decomposed by acids with the production of hydrocyanic acid, which can be removed from the water by bubbling air through it. Sulphuric acid is recommended because it is non-volatile and inexpensive.

Acid-decomposition method

The waste can best be treated in batches. In actual practice a day's supply would constitute a batch. The acid required is ten per cent more than the amount necessary to neutralize the alkalinity and decompose the cyanide. The pH of the solution must be kept below 6.0 or decomposition will not take place. Aeration, accomplished by means of diffusor plates, is used to mix the acid with the waste and carry off the HCN as it is produced. An occasional test for cyanide will tell when the process is complete. The hazard due to the poisonous nature of the HCN gas can be eliminated by carrying the mixed air and gas well up into the atmosphere by means of a tall stack, with further dilution of the gas by installing a fan on a side arm so that it will operate inward.

Fish tests were made by Dr. Hubbs, and the resultant products show that while the fish were killed in dilutions of 1 to 400 of the original KCN waste before the treatment, they were not killed in a 1 to 1 dilution after treatment.

Potassium permanganate method

According to the permanganate method, the cyanides are oxidized to cyanates by potassium permanganate in neutral or alkaline solution, the reaction being quantitative if sufficient time is allowed. The reaction velocity increases with the temperature.

In these studies 5-gal. batches of the waste containing about 200 p.p.m. cyanide as KCN were treated with the calculated amount of potassium permanganate. For oxidation, 1.62 parts of potassium permanganate are required for one part of KCN, or its equivalent of some other cyanide. Mixing was accomplished by air diffusion. The temperature of the mixtures varied between 18 and 22 deg. C., and the pH between 7.0 and 7.8.

To duplicate practical conditions, the mixtures were made up and treated in the late afternoon, then allowed to stand over night. By morning the cyanide was found to be completely oxidized and the manganic oxide sludge was settled in the hopper bottom of the tank. The sludge was then drawn into a small sand bed where it dried very rapidly. Toxicity tests made by Dr. Hubbs on both clear effluent and sludge showed that fish would live in a 1 to 1 dilution with aquarium water. Apparently the sludge solids did not exert a toxic effect if the sludge liquor were diluted.

In treating a vat of plating solution by either method the solution must be diluted until the cyanide content as KCN is less than 500 p.p.m.

The author wishes to acknowledge the assistance of Dr. Carl L. Hubbs, of the Institute for Fisheries Research, University of Michigan, in making the fish tests reported in this study.

Mountain Road Relocation Based on Traffic Analysis

Relocation modernizes major link in California highway system—Comparison with highway standards of sixteen years ago—Economics of improvement analyzed—Stream realignment to avoid two bridges is construction feature

By S. V. Cortelyou
District Engineer, State Division of Highways, Sacramento, Calif.

TO MODERNIZE the principal traffic artery between metropolitan Los Angeles and the central valley region to the north, the California division of highways has just completed a $3,000,000 relocation of the Ridge Route over the Tehachapi Mountains. The work has been under way since 1930 and has involved the construction of 26 miles of modern highway, including 3,900,000 cu.yd. of excavation, seven bridges and a 2,000-ft. concrete channel for a creek to eliminate two other stream crossings. A conservative estimate of the savings to be realized by the traffic over the new route as compared to the old is $1,369,000 annually for the next ten-year period. The project represents one of the outstanding pieces of recent California highway construction and an example of modern highway development.

For a proper appreciation of the project it is necessary to outline briefly the background of this highway route. In the early days of the California Highway Commission, 1912, two principal routes were under consideration (Fig. 2). The so-called Tehachapi Route extended east from Bakersfield through Tehachapi Pass to Mojave, thence south through Antelope Valley to its southern extremity near Palmdale and southwest to Saugus. This route followed the Southern Pacific Railroad line, in general, and involved comparatively light construction. The other route, known as the Tejon or Ridge Route, extended south from Bakersfield on nearly a direct line toward Los Angeles, in general following the mountain ridges down the southern slope to Saugus, 50 miles north of Los Angeles. This line was about 50 miles shorter than the Tehachapi Route, but a large part of it was in extremely rough country that would involve comparatively high construction costs. The problem at that time was to locate a highway along the shorter route, if possible, and not exceed the limited funds available for the purpose.

The Ridge Route, following the most readily accessible and least expensive location on this general alignment, was surveyed, adopted and built. In 1916 this highway was considered one of the most important links in the state system and was looked upon as a great achievement in highway construction, principally on account of what was considered, at that time, the enormous amount of excavation involved. It conformed to the recognized standards of alignment and grade of that period of highway construction.

With the increase in highway traffic and higher speeds, the curves on the Ridge Route were found to be dangerous and were gradually improved by "daylighting" and finally by removing the points. Some of these crescent-shaped areas were paved with light bituminous-type pavement. These improvements materially increased the safety of the highway. The alignment and daylighting of the worst curves were completed about June, 1930.

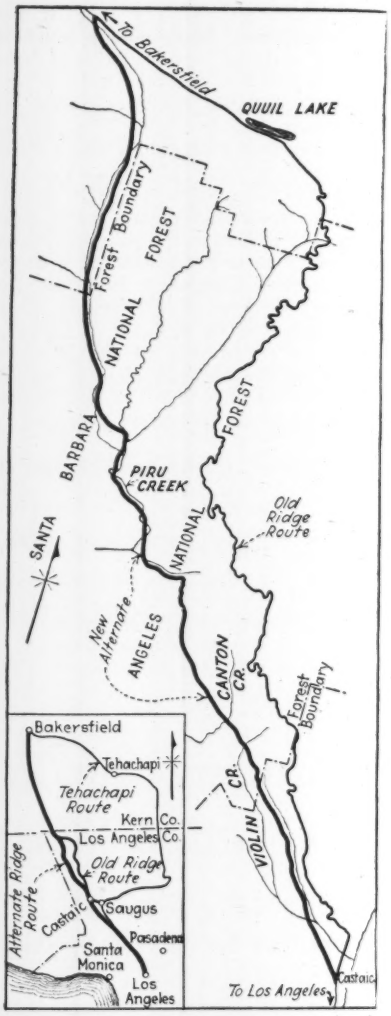


Fig. 2—Plan of the old and new Ridge Route in California. The improvement in alignment resulted in a saving of 10 miles in distance, and the change in profile eliminated serious snow conditions. The key map shows the relation between the Tehachapi route, the Ridge Route and the new alternate.

During these years the volume of traffic continued to increase in volume and speed. Curves that were gradual enough for the slow-moving traffic of 1916 became too abrupt. Pavement that was considered wide enough and thick enough at the earlier date was inade-

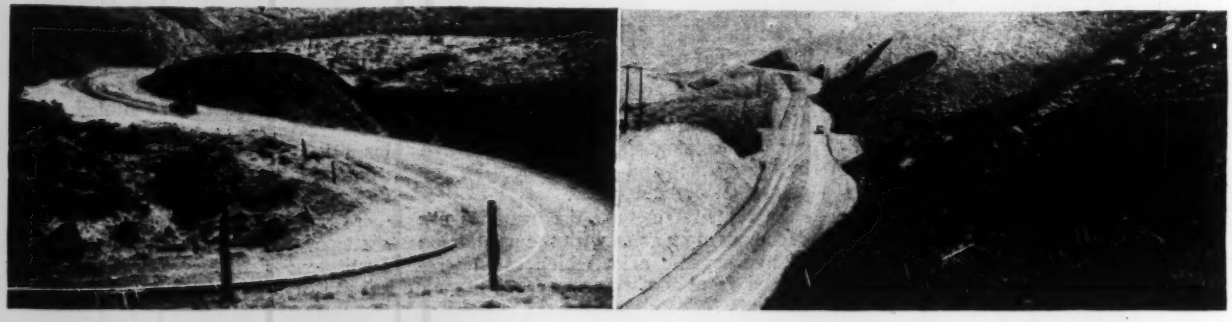


Fig. 1—The old and the new highway connecting Los Angeles with central California. Left: The Ridge Route section of state highway, 36.4 miles long with minimum curves of 70-ft. radius built in 1916; and (right) the new alternate route just completed, 26.8 miles long with 1,000-ft. curves.

quate for the increased volume of traffic and the heavier loads. It became increasingly evident that the Ridge Route would have to be either reconstructed or replaced. With the probable increase in traffic and consequent revenue from the gas tax, it seemed probable that a new route would be more satisfactory and economical, though the first cost of construction might be high.

Several reconnaissance surveys were made, following shorter routes. The one that seemed to be the most direct, economical and permanent was a route extending in nearly a direct line from Castaic School at the southern end of the present Ridge Route to Gorman, near the Kern County line. This new line lies to the west of the present Ridge Route the entire distance (Fig. 2).

Further surveys in 1929 indicated so many advantages for the new location that all plans for reconstructing the old highway were abandoned. A few comparisons of the characteristics of the two routes are shown in the table on p. 681. It will be noted that the improvements of the new route include: (1) shortening the distance 9.6 miles in 36.4 miles; (2) reducing the total curvature by 93 per cent; (3) increasing the minimum radius of curvature from 70 to 1,000 ft.; and (4) providing a 50 per cent increase in paving width with roadbed allowance for additional widening. Further, the highest elevation on the new road is 684 ft. below that on the old route. The average elevation also is considerably lower so that interference from snow will be appreciably lessened. Three troublesome snow summits are eliminated. The maximum grade remains the same at 6 per cent, but it will be compensated for curvature as well as broken by long stretches of minor grade.

Economics proved

In 1929, when the study of the alternate route was being made, the average daily traffic over the Ridge Route was about 2,100 automobiles, 200 trucks and 620 tons of freight. Based on increases in volume of traffic for several years, it was the conservative estimate that during the next ten years the average traffic would increase 75 per cent. The average daily traffic for the ten-year period was therefore estimated as 3,600 cars, 350 trucks and 1,100 tons of freight. Based on this traffic, some startling figures on the savings made possible by the new route for the ten-year period were derived.

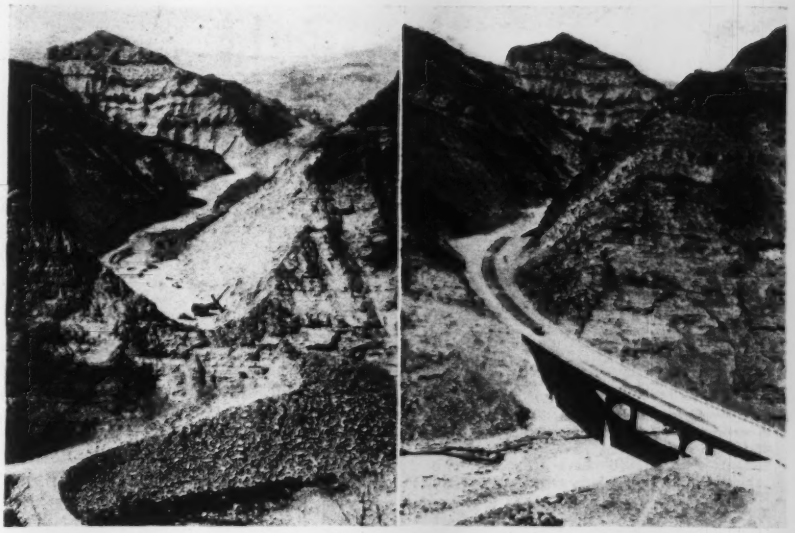


Fig. 3—A 230,000-cu.yd. cut in progress (left) and the same section after completion, showing the cut and the creek crossing (right).

Assuming a cost of 6c. per ton-mile for hauling freight, 4c. per mile for operating a car and 25c. for moving buses and empty trucks, shortening the distance by 9.6 miles will result in an annual saving of $867,000. Elimination of 1,180 ft. of adverse grade, all sharp curvature, stretches of grade exceeding 6 per cent maximum and the other modern features are expected to reduce operating expenses on the other 26.85 miles at least 1c. per mile as an average for all vehicles. This will amount to an annual saving in operation of $392,000.

By providing high standards of alignment and grade, an analysis of prevailing speeds on the old route indicates that the average speed should increase 50 per cent for all classes of vehicles except the heaviest trucks. Light vehicles will cut an average of 45 min. from average time over present routing, equivalent to an annual saving of 985,500 hours.

This element of time saved cannot be valued accurately, but it is a definite advantage, particularly to business men. To commercial vehicles this time element is given an approximate monetary value. Assuming 30 min. saved for each truck and with driver's salary and rental value of 3 per hour, there is an annual saving of $110,000. Other savings of the new location such as safety, comfort and decreased maintenance of roadway have not been calculated and are not considered in this comparison. Summing up the tangible values of saving, the figures show:

Reduced distance	$ 867,000
Lower operating cost on shorter route	392,000
Time factor on commercial vehicles	110,000
Total annual savings (10 year)	$1,369,000

The cost of the new route is about $2,900,000. The annual savings capitalized at 5 per cent equal $27,380,000, which is roughly 9½ times the cost of

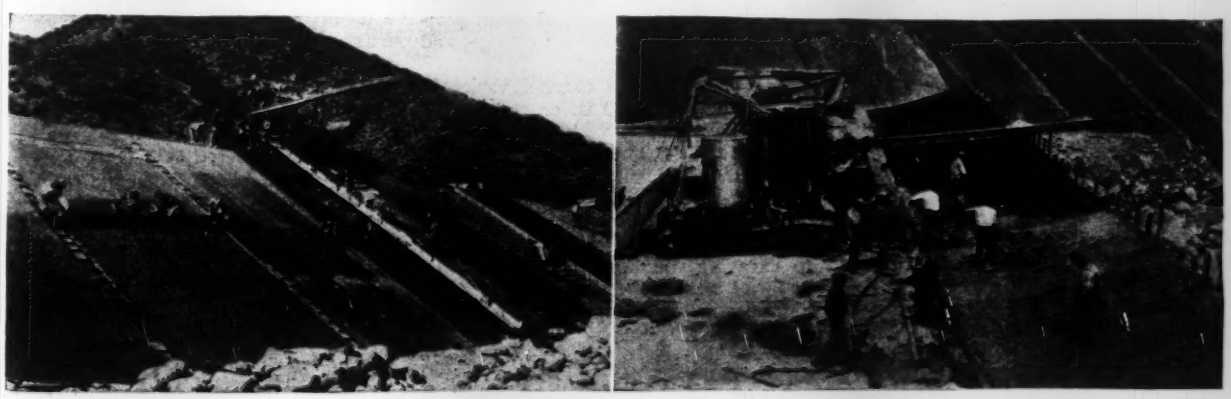


Fig. 4—Paving the sloping side of the channel (left) that diverted Piru Creek for 1,900 ft. to save two bridges; and building a deflecting lip (right) on the lower end of the channel to throw the discharge 60 ft. and eliminate undercutting.

Fig. 5—Completed section at Piru Creek diversion, showing concrete channel at right and highway crossing the old loop of the stream that would have required two bridges.

the improvement. The annual saving in cost of operation of present traffic is sufficient to repay the entire cost of grading and paving this new highway in slightly more than two years' time.

Heavy grading

The first grading contract for the southern 7.1 miles was awarded in February, 1930. The second grading contract for 7.32 miles followed in April, 1931, and the final 12.5-mile section was let in July, 1931. In addition to these three original contracts for the length of the project, a fourth grading contract was awarded August, 1933, for removing slides that had occurred on the first contract subsequent to completion and also for placing additional material adjacent to the toe of the slope along the high fill that crosses Violin Saddle.

These four contracts involve the excavation of 3,900,000 cu.yd. of earth and rock. At times there were as many as ten power shovels working three shifts per day, and a maximum of 50 dump trucks were required to handle the output.

In addition to the usual culverts, overside drains and minor structures, seven bridges were built varying from 75 to 360 ft. in length. These bridges are all steel-girder structures with concrete piers and floor slabs, with one exception, which is a reinforced-concrete slab with frame bents. Construction of several of these bridges was made necessary by the devious course of Piru Creek, the high standards of alignment making it necessary to cross and recross this creek rather than use shorter radius curves.

Creek relocated

At one location a channel change to divert Piru Creek in a concrete-lined bed along the highway embankment was made to eliminate two bridges. This channel relocation is between French Flat and Liebre Creek, about 13 miles from the south end of the project. The located line crosses the channel of Piru Creek at two places about 1,900 ft. apart, where the stream makes a sharp turn. The most obvious procedure would have been to build a bridge at each location, but the possible alternative was to change the course of the stream by cutting the channel through the point.

It was evident that there would be several difficulties encountered if the channel change were adopted in addition to the required cut 75 ft. deep involving the removal of 118,000 cu.yd. of earth and rock. With the stream channel shortened considerably by the change, a much higher velocity would result. As the new roadway embankment would parallel the new channel, it was apparent that in times of high water the embankment would be undercut and seriously damaged unless some means were provided for controlling the erosion.

The runoff from the 300 square miles of mountain watershed is only a few second-feet during the summer months, but in years of heavy snowfall spring floods reach torrential proportions. Huge boulders are often rolled down the streambed. The new channel had to be lined with concrete sufficiently strong to withstand the scouring action of these boulder-rolling floods as well as to have capacity for maximum flow.

These requirements made necessary a careful estimate of cost of the channel as compared to the cost of constructing two bridges with the necessary bank protection at the approaches. The analysis showed a saving of about $75,000 in favor of the channel change, and this design was adopted.

The concrete-lined channel varies in width from 40 to 90 ft. on the bottom and is 25 ft. deep, with a capacity of 40,000 sec.-ft. The bottom was lined with a 1-ft. thickness of concrete, and this lining was carried 16 ft. up the sides and then tapered to a thickness of 6 in. at the top. Power shovels were used to excavate the new channel, and the material was hauled in trucks to make highway embankments. Concrete was poured on the channel slopes in 20-ft. sections. It was struck off by a heavy screed pulled up the 1½:1 slope by a tractor and drum hoist. Two men riding this screed filled in low places.

The design of the outlet end of the concrete-lined channel required special study. The high velocity attained by the water in the channel would tend to undercut the end of the paving and wingwalls without some provision for dissipating the force of the water. Studies were made on methods of controlling the undercutting action. Much valuable information was obtained from the results of a series of model tests made at the Alden Hydraulic Laboratory, Worcester Polytechnic Institute, where a scale model was built with a glass side for observing the action of the water. These tests showed the best results with the use of an outlet which deflected the water upward at an angle of about 12½ deg. This type produced no appreciable erosion for a distance of 60 ft. from the end of the channel. When used later on an actual dam spillway, the results were almost exactly as predicted from the model experiments.

The outlet end of the Piru Creek channel was designed on a basis of these results. A heavy cutoff wall was constructed at the end of the concrete lining with a flaring wingwall on each side, and the space at the bottom of the walls was filled with heavy boulders. In addition, three groins of boulders were built at about right angles to each wingwall, extending out into the stream to break the back eddy. The fast-moving water at the outlet end will be deflected upward and literally pitched for a distance of 60 ft. from the mouth of the channel. Much of its energy will be dissipated in this process, and any erosive action will be at such a distance below the concrete work as not to undercut or endanger it.

Fill construction

In keeping with modern highway construction practice, embankments on the new Ridge Route have been placed in thin layers, each layer being wet and rolled before the succeeding layer was spread. This has resulted in thoroughly compacted embankments on which pavement could be placed immediately, without waiting a year or more for the fills to settle.

An interesting problem developed in a fill across Violin Saddle, which has a maximum depth of 80 ft. The embankment contains about 230,000 cu.yd. of material and was constructed in 8-in. layers, watered and rolled. Construction of the embankment occupied from July to November, 1930.

On Oct. 27, 1930, when the embankment was only 10 ft. below profile grade, a crack appeared in the natural ground about 20 ft. to the left of the toe of the fill on the west side. When first noticed, this crack was 1½ in. wide, 50 ft. long and, in general, ran parallel to the fill. A series of instrument points was set, both on the fill and on natural ground, and careful records were kept

of the movement that has continued since 1930.

The maximum lateral displacement is along the east embankment toe, and by June 6, 1933, it had amounted to 46.85 in. The fill and the ground under it have moved east toward a steep canyon which parallels the center line. The movement has been fairly uniform, varying from 1.1 to 2.7 in. per month. The maximum settlement from profile grade has been about 1 ft. during this time.

Shortly after movement of the fill was first noticed, test holes were drilled along the east side of the embankment in an effort to locate the plane of slippage. The top soil varied from 2 to 15 ft. in depth, below which strata of shattered sandstone, clay and shale and hard sandstone were encountered. Test holes were abandoned at depths ranging from 6 to 40 ft. on account of the hard material encountered.

In June, 1933, geologists made a field study of conditions in the vicinity of this fill. They reported that the fill rested on the west slope of a syncline with strata of broken, soft dark grey shales dipping 60 deg. at right angles to the fill toward the canyon just east of the fill, and that the shales are subject to sliding on their bedding planes from the superimposed weight of the embankment.

It was decided to fill the canyon toward which the fill is slipping to an elevation slightly above the toe of the slope, adding sufficient water to the embankment material as it was spread in layers and rolled to obtain maximum compaction in an effort to support and stabilize the natural ground and prevent further movement. The material for this supporting embankment is provided in the fourth grading contract.

Paving

The pavement is concrete 30 ft. wide, one 10-ft. strip being poured at a time. The one exception is the Violin Saddle fill, which on account of settlement is being paved with bituminous-treated surfacing. Particular attention has been given to preparing subgrade, and only material of low shrinkage has been used in the top foot of embankments. Where unsuitable material has been encountered in excavation, this has been excavated to a depth of 1 ft. below subgrade elevation and replaced with selected material of low shrinkage.

The pavement is 0.6 ft. thick, increasing to a thickness of 0.75 ft. at the outer 2 ft. of each 10-ft. strip and is superelevated on curves. Expansion joints are placed every 60 ft. with weakened plane joints at intermediate 20-ft. spacing. Marginal reinforcing of two ½-in. bars is used on each 20-ft. panel, and slabs are doweled with ¾-in. dowels in sliding sleeves at expansion joints. Local aggregates were obtained from Piru Creek and proportioned in a portable plant. Cement was bulked and weighed separately for each batch.

COMPARISON OF PRINCIPAL CHARACTERISTICS OF THE NEW AND OLD ROUTES

Items	Old Ridge Route	New Ridge Route
Length, miles	36.45	26.85
Total curvature, deg.	35,141	2,492
Highest elevation, ft.	4,234	3,550
Minimum radius of curves, ft.	70	1,000
Maximum grade, %	6 (uncompensated)	6 (compensated for curvature)
Total rise, ft.	4,630	3,450
Adverse grade, ft.	2,220	1,040
Roadbed width, ft.	21-24 (original contract)	38
Width of pavement, ft.	20	30

The question has been asked many times why, with such a location as the new Ridge Route possible, it was not built originally in place of the tortuous alignment of the old Ridge Route. The explanation is found in the limited funds available in 1912, the relative small amount of travel and the highway construction equipment of that date. The average cost per yard of excavation on the old route was 42c., that on the new route 30c. There were but 1,023,000 cu.yd. of excavation on the old route—on the new there were 3,900,000 cu.yd. The old route required 393,000 station yards of overhaul, the new route has 24,324,000 station yards, or 62 times as much, and the contract price per station was about one-third.

The cost of grading and structures alone on a road similar to the Ridge Route alternate at the contract prices paid for the original Ridge Route would be $2,549,000, or nearly five times the cost of this work on the original route. It would have cost nearly one-seventh of the original state highway bond issue, which had to be apportioned over the entire state at that time.

This project is being handled by the California division of highways, of which C. H. Purcell is state highway engineer. Fred J. Grumm is engineer of surveys and plans, and C. S. Pope is construction engineer.

Location and construction has been handled locally by the District VII organization, of which R. L. Thomas is location engineer and L. M. Ransom district construction engineer. The writer as district engineer has been in charge of the project.

Extending a Bank Into an Adjacent Building

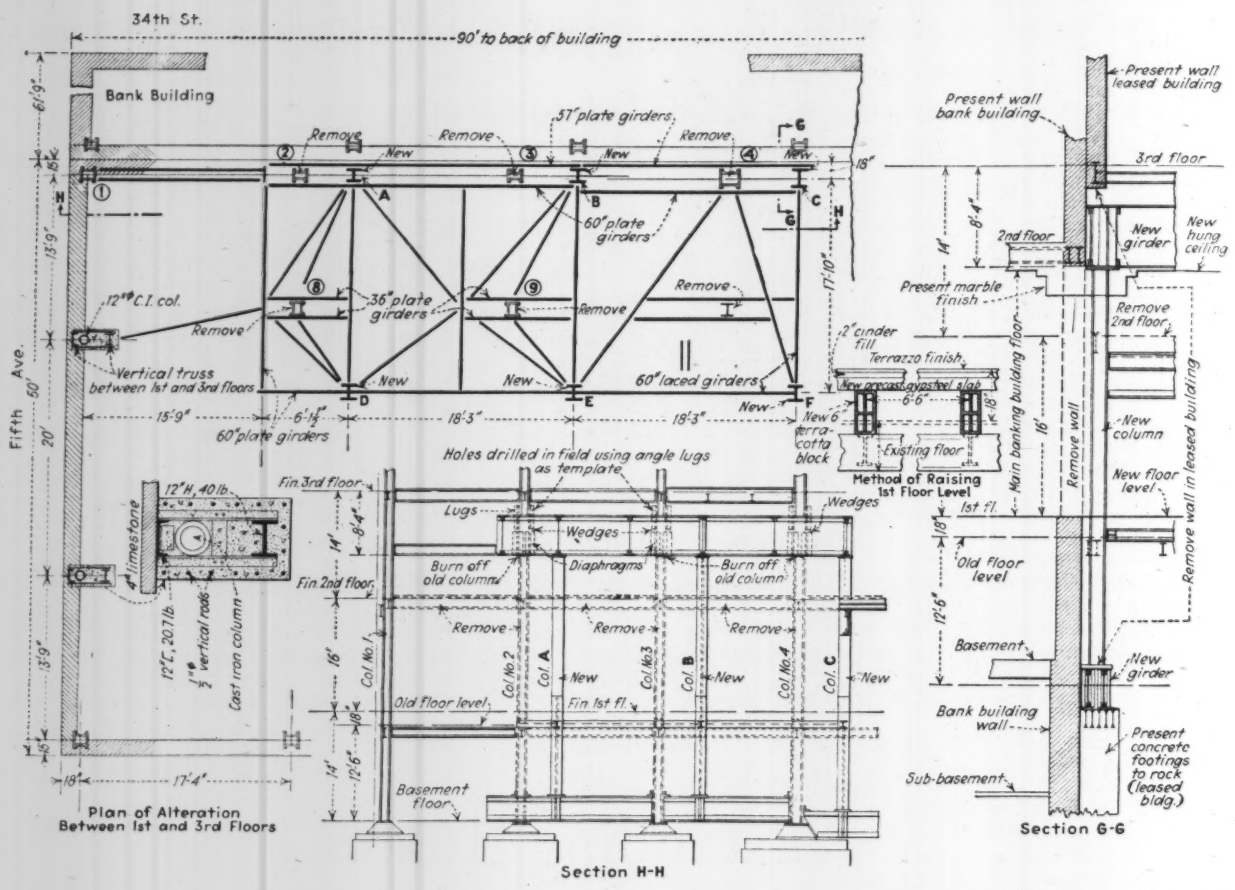
By Julius Eckmann
Consulting Engineer, New York, N. Y.

AN INTERESTING and difficult building-alteration job has been completed in New York City in connection with the extension of the Bowery Savings Bank on the corner of Fifth Ave. and 34th St. into a thirteen-story building adjoining it on the north.

In November, 1931, the Bowery Savings Bank opened a branch bank at the corner location in a fourteen-story structure, the ground floor, basement and sub-basement of which had previously been occupied as a bank. Within a few months it became evident that the savings-bank facilities would have to be increased. After examination of the building next door, the bank, upon the advice of the architect, leased the basement, first and second floors for a period of years. Permission was granted to make such changes in the leased portion as were necessary to combine the two buildings into a unified bank, but no access could be obtained to any of the upper floors for construction purposes.

The first-floor levels of the two buildings did not correspond. The walls between the two buildings had to be removed, and the columns in the walls did not correspond in alignment, nor did the interior columns of the leased building align with those of the bank building. The height of the main bank story was considerably in excess of the first-story height of the leased building, and it was for this reason that the second story was included in the lease, thus permitting the required structural framing to be placed in the excess height below the third floor; also the rear of the second floor, where not removed, could be utilized for office space.

For purposes of efficient bank operation as well as for architectural reasons, the main bank floor level and ceiling height had to be uniform throughout and the columns of the leased building relocated in alignment with those of the bank. At the same time the bank could not be disturbed in any manner, either by access, work, materials, noise or dust. The structural work involved the removal and relocation of six columns carrying loads (dead plus live) up to 1,000 kips, the removal of most of the second-story framing, installation of new foundations, redistribution of wall-column loads on existing foundations and



Details of framing required to alter the leased building to conform with column alignment and ceiling height in the existing bank building next door.

changes to the front of the building at the second story.

An unusual condition existed in the front of the building where there were two 12-in.-diameter cast-iron columns. The removal of the second-story beams left these columns with no bracing at the second story. A method of stiffening was devised in which a vertical truss, as indicated on the drawing, was used. The chords of the truss, a channel and an I-beam, were braced in about 4-ft. panels by angle struts and diagonals. The truss and the cast-iron columns were then incased in concrete, giving a composite column stiff enough for the unsupported length of nearly 30 ft.

The new framing required by the removal of the old columns and the insertion of new columns lining up with the columns in the bank building consisted of a layout of girders and bracing as shown in the accompanying illustration. Diaphragms were welded to the girders at each old column location. These girders were placed in pairs, one on either side of the old columns and resting on the new columns. Lugs made of heavy angles were then carefully fitted against the old columns at the proper distance above the diaphragm to permit wedges to enter between. Holes were drilled in the old columns, the lugs (previously sub-punched) being used as templets.

After the legs had been riveted to the old columns, the wedges were driven up tight, thus transferring the loads from the old columns to the girders and then into the new columns. After all framing was completely riveted, the six old columns were successively burned off, the lower end of each being immediately connected to the new girders. All six columns were removed in one day. Measurements taken by transit showed one deflection of about $\frac{3}{32}$ in., while at other points measurements showed from zero to $\frac{3}{64}$-in. deflections.

The structural contract called for all work to be completed within eighteen working days, which clause was complied with. The structural steel contractor was the Taylor-Fichter Steel Construction Co., New York. Marc Eidlitz & Son, Inc., New York was the general contractor. Henry M. Clawson, New York, was the architect, and the writer was the structural engineer.

Boulder Dam Generators to Be World's Largest

BOULDER DAM'S electric generators will be the world's largest both electrically and physically, it has been announced by the General Electric Co., to whom the contract for the first two units has been awarded. Work has been started on the units at Schenectady, with the first unit scheduled for completed installation early in 1935. The units are rated at 82,500 kva. each, exceeding in capacity any now in operation. Each weighs over 2,000,000 lb. and will have an over-all diameter of 40 ft. and height of 32 ft. above floor level. At least 40 freight cars will be required for the transportation of each unit. Due to the 265-mile transmission line, special features of design will be incorporated, making each unit equivalent in size to one of approximately 125,000 kva. in units of normal characteristics. The contract for two similar units to be installed later has been awarded to the Westinghouse Electric and Manufacturing Co.

The preliminary installation will be completed by a 40,000-kva. generator, contract for which has been let to the Allis-Chalmers Manufacturing Co. Eventually, it is planned to install a total of fifteen 85,000-kva. units and two 40,000-kva. units.

Bridge Capacity Increased From 12 to 30 Tons

Pin-connected truss span of 100 ft. strengthened under traffic and without falsework by welded reinforcement—New tension members attached to pins after being lengthened by heating, to assure carrying of dead-load stress

By Frank B. Doolittle
The Leake & Nelson Co., Bridgeport, Conn.

THE BROAD possibilities of bringing old bridges up to present-day capacity requirements by the use of modern methods employing arc-welding has been well demonstrated by the recent strengthening of the highway bridge at the Peekskill plant of the Fleischmann Yeast Co., subsidiary of Standard Brands, Inc. This structure, carrying a highway over the New York Central Railroad main-line tracks, furnishes the only vehicular access to the extensive plant as well as to a number of residences, and carries a heavy traffic of both commercial and passenger vehicles.

The bridge consists of a 100-ft. pony pin-truss span and a 28-ft. I-beam approach span and was originally erected in 1899. It was designed for the equivalent of 7-ton trucks, but in 1921 it was strengthened for 12-ton trucks, by riveting reinforcing to the top chord, by supplementing the eyebar diagonals and bottom-chord members with loop rods and turnbuckles and by replacing the light stringers with heavier beams.

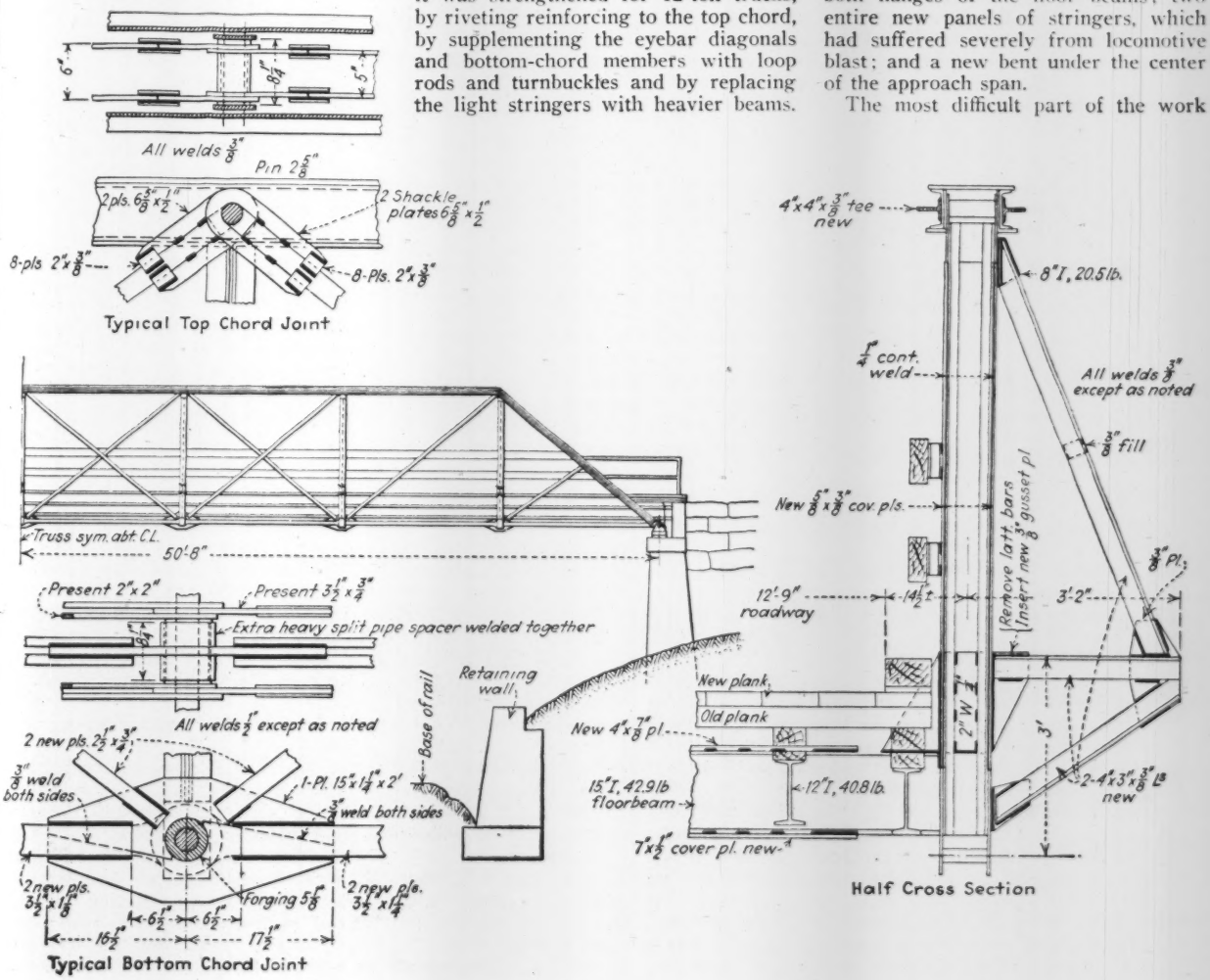
As highway loadings continued to increase, it was found advisable in 1932 again to increase the capacity, and it was decided to avoid further expense by providing a bridge that would have sufficient capacity to carry a truck of 30 tons gross weight, assuming 14-ft. axle spacing and 25 tons of the load concentrated on the rear axle.

The firm with which the writer is associated was called upon to determine whether the existing structure could be strengthened to carry such a load, the work to be done without interference with traffic. The alternative involved a new bridge and also the construction of a temporary bridge with expensive approaches, or the installation of a temporary and dangerous grade-crossing, since uninterrupted access to the plant was essential. Plans for strengthening by arc-welding were prepared which met every requirement and which indicated a cost of less than one-third that of a new bridge. They were checked and approved by the engineers of Standard Brands and of the New York Central Railroad.

Strengthening involved additional section in the chords, verticals and diagonals of the trusses; new coverplates on both flanges of the floor beams; two entire new panels of stringers, which had suffered severely from locomotive blast; and a new bent under the center of the approach span.

The most difficult part of the work

Details of truss-strengthening by welding, which included prestressing of new tension members and addition of section to compression members.



was the strengthening of the trusses and particularly the provision of additional section in the bottom-chord and diagonal members. Since the dead-load stress represented a material percentage of the total stress, it was desirable that the new material should work with the old, taking its share of dead load. This was accomplished without the use of falsework and without stripping the bridge, by installing supplementary members prestressed in accordance with the patented Leake method. In applying this method, a different application of which was discussed in *Engineering News-Record*, Oct. 24, 1929, p. 642, the stretch of the new member necessary to cause it to take the correct final dead-load stress is first computed. The new material is then placed in position and the connection to the pin at one end made as outlined below. It is then expanded the predetermined amount by applying a moderate heat, and the pin connection at the other end is completed. After cooling, the member assumes the desired stress.

In the bottom chord the center of the pin was the only clear space available for new material, inasmuch as the bridge had to be kept in service for 12-ton loads, and the existing loop rods had to function in each member until the new member material was installed. New gussets were accordingly prepared, as shown in the accompanying drawing, drilled to fit the pin and then cut in half. These were then placed in position around the pin and butt-welded, forming a single plate. The new bottom-chord bars were then welded to these plates and prestressed to take their share of dead load. Thus a continuous new bottom chord was provided without excess bending on the pin, since the major part of the stress in each panel was carried to the next panel directly through the new gusset.

To provide connections for the diagonal bars on the top chord, shackle plates were placed over the pins, and the bars welded to them as shown in the typical detail. The shackles were placed close to the webs of the top chord to avoid excessive bending in the pins. As a final operation, the diagonal bars were prestressed and welded to the bottom-chord gusset.

The installation of this new material required a carefully developed program to keep the bridge safe for traffic, as the position of the loop rods frequently required their removal in a completed panel, to permit installation of new material in the next. Careful consideration also was necessary to avoid undue temporary transfer of stress from one member of the truss to another. The accuracy of the program is best indicated by the fact that the work on these trusses was carried to successful completion without closing the bridge to 12-ton loads, except for two periods of three hours each and three periods of one-half hour. These periods were arranged for in advance to avoid inconvenience to plant operation. At no time were loads under 2 tons barred from the bridge.

The strengthening of the truss members constituted the major part of the work. The top chord and batter posts were stiffened laterally by the addition of tees welded to the webs of the members. The vertical truss members were reinforced by the addition of flange plates. In addition, stiffening brackets were added at each panel point. An interesting feature of these brackets is the carrying of the main gusset through the vertical post and welding it to the top flange of the floor beam as well as to the post, giving it a high stiffening value.

The plans for this job were prepared and the work performed by the Leake and Nelson Co., of Bridgeport, Conn.

Vibration as a Means of Placing Concrete

Economy through cement saving and better concrete through reduced water content are advantages of vibrated or mechanically-puddled concrete—Data on choice of a vibrator

By T. C. Powers
Associate Engineer, Portland Cement Association, Chicago, Ill.

THE USE of vibration as an aid in concrete placing has recently attracted wide attention. Unlike the cold reception sometimes accorded innovations, the general reaction to this development has been favorable. On the other hand, there are those whose experience with vibration has not been altogether happy. They have seen forms fail under its action. Honeycomb has appeared when the forms were stripped. Finished surfaces have been pock-marked with large air bubbles. And, in some cases, machines have broken down when they were most needed. In contrast to such conditions, other users of vibration have produced better concrete, lowered costs, or both, or have successfully placed concrete under conditions which were almost impossible by hand methods. These conflicting opinions raise the question as to just how much value there is in vibration. Has it real merit or is it a passing fad?

Laboratory studies

On the basis of recent studies made in the laboratory of the Portland Cement Association and of the confirmatory results of tests made in the engineering laboratories of the University of California (*Proceedings*, Am. Concrete Inst., 1933; also *Journal*, A.C.I., June, 1933, and Sept.-Oct., 1933), it can be stated unhesitatingly that vibration has great value as a means of placing concrete. For example, it has been found that when vibration is *effectively* applied, 5,000-lb. concrete can be made with about the same amount of cement that will give 3,000-lb. concrete with hand placing. Or, concrete of a given strength can be made with 1½ to 2 sacks per cu.yd. less cement than is required when placing by hand. More significant than these figures on strength and cement content is the fact that the water content of vibrated concrete may be reduced 8 or 9 gal. per cu.yd., thus eliminating more than 1 cu.ft. of the least desirable ingredient.

It is this reduction in water that makes possible the substantial economies or improvements indicated above. It is of perhaps equal importance that it must also effect a substantial reduction in shrinkage. Estimates made on the basis of existing data indicate that shrinkage may be reduced to nearly one-half that of comparable hand-placed concrete. Such a reduction in shrinkage opens the way for the use of extremely high-grade concrete, impracticable in the past because of the high shrinkage of the very rich mixes required. For example, 4½-gal.-per-sack concrete containing only 6 sacks of cement per cubic yard can be placed by vibration, whereas it would require at least 8 sacks for such a water ratio when placing by hand.

The type of mix mentioned above (4½ gal. per sack, 6 sacks per cu.yd.) has seldom been used. It is truly stone-like; in fact, about 80 per cent of the total volume of such concrete actually is solid stone and the rest is made up of a hardened paste, itself of stone-like density. Such concrete weighs over 156 lb. per cubic foot, its specific gravity being but little below that of the aggregate which it contains.

In the range of concrete of good quality for ordinary uses—say, 6 gal. of water per sack of cement—mixtures with only 4 sacks of cement per cubic yard of concrete can be placed by vibration. Laboratory tests indicate that such concrete is in no way inferior to hand-placed richer mixes *having the same water-cement ratio*. From the standpoint of volume change, the vibrated concrete

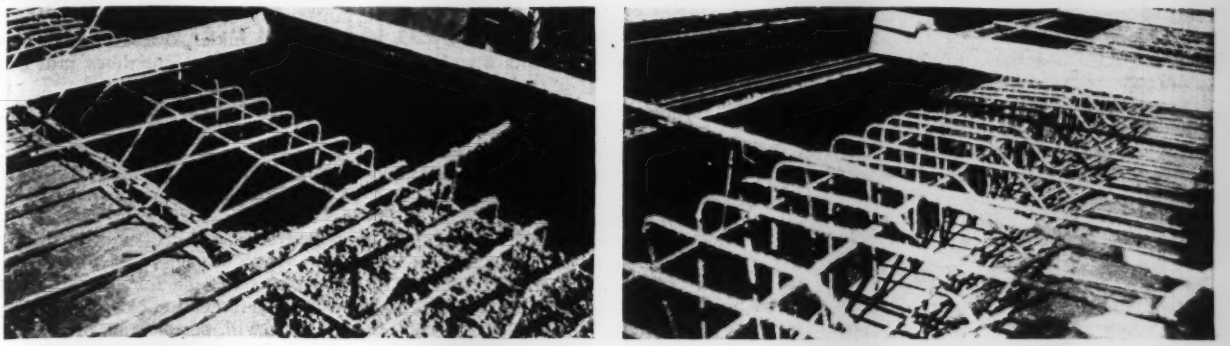


Fig. 1—Stiff concrete (at left) which was reduced to condition shown at right by an internal vibrator working at a rate of 24 cu.yd. per hour.

should be superior because of the lower paste content and consequent low uncombined water.

It should be made clear that each comparison made above is between mixes differing widely as to workability—one suitable for hand placing and the other suitable for placing by vibration under laboratory conditions. Laboratory tests have clearly established that vibration itself does not impart new properties to the finished concrete. Just as for hand-placed concrete, the water-cement ratio is the chief factor determining the potential quality of vibrated concrete. This simply means that any benefits to be derived from vibration must come from the saving in labor cost through greater speed and efficiency in placing under difficult conditions, from improvements in quality, or from economies brought about by changes in composition of the concrete.

Laboratory studies have generally emphasized the possibilities of improving quality or lowering cost through changes in mixture composition made possible by vibration. While these improvements are important, the advantage of vibration as a means of placing under adverse conditions is of considerable importance. In viaduct construction, for example, where heavy steel girders are incased in concrete or where many of the members are heavily congested with reinforcement, vibration makes it possible to flow the concrete through small openings and into otherwise inaccessible places.

It should be noted that it was stipulated that the results described were those obtained from the *effective* application of vibration. In the field, vibration is not always effectively applied; consequently, the desired results are not always obtained. Even the best field results are not likely to be as good as those obtained in the laboratory. In fact, in three different field studies in which vibration gave good results, the improvement in quality or possible reduction in cement content was found to be about *one-half* of that shown to be possible under laboratory conditions.

The excellent results obtained in the laboratory, however, should serve as a challenge to the developers of construction equipment and to all those who use concrete. Laboratory results may be considered a goal which it is certainly not impossible to attain, although there are many obstacles yet to be overcome. These obstacles arise chiefly from the fact that maximum results are obtained from the use of very dry mixes containing the minimum of sand. To mix and convey such material and place it in the forms ready for vibration is a problem not easily solved under many conditions. Even when transportation is properly done, it is not always an easy matter to apply a sufficiently intense vibration to compact the mass at a reasonable speed.

Many other details could be cited to show the difficulty in attaining maximum laboratory results in the field. Fortunately, however, it is not necessary to obtain maximum results in order to make vibration worth while. Even though the water content could not be reduced 8 or 9 gal. per cu.yd. as was done in the laboratory, it has been reduced as much as 5 gal. under field conditions with present-day equipment. It should be remembered also that under most conditions, extremes are to be avoided. While it is possible to improve quality by using vibration on extremely dry and harsh mixes, there may be other less expensive ways of effecting the desired improvement. On the other hand, if ordinary mixes having sufficient workability for hand placing are used, a vibrator may prove to be a needless expense. A medium ground should be found where the design of the mix is balanced with the capacity of the vibrator, so as to derive the most benefit.

The full value of vibration cannot be realized, even in its present degree of development, until provisions for it are made in plans and specifications. These should require strong and tight forms and mixes to fit the needs of the vibrator, the condition of placement and the proper water-cement ratio.

Choice of vibrator

The choice of vibrator for a particular piece of work is still a matter of personal judgment and trial. In this connection, however, knowledge of certain fundamentals should be helpful. Laboratory studies have shown that the function of vibration is not quite the same as might naturally be supposed. It is a common impression that vibra-

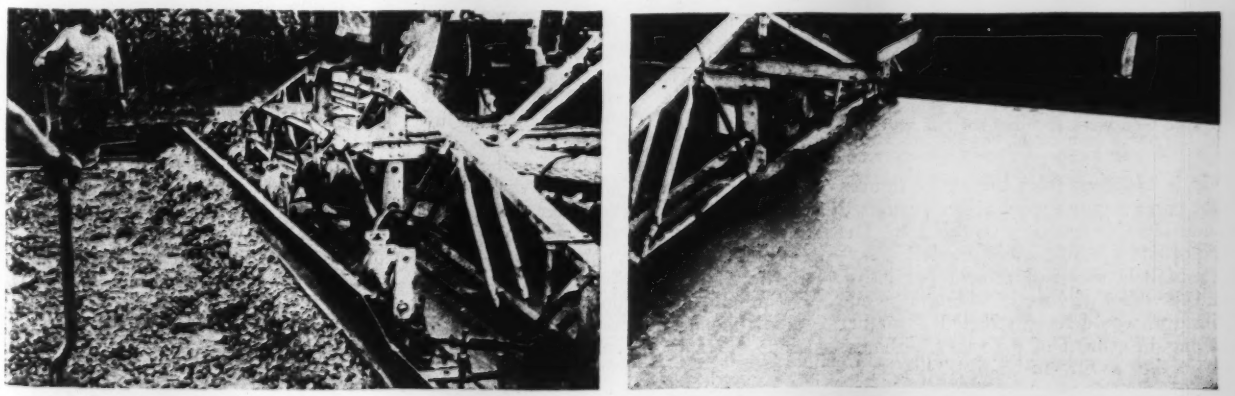


Fig. 2—In an experimental application of vibration to highway concrete the views below show the condition of the mix before and after the machine has passed.

tion is a form of tamping at high speed—a process of driving the aggregate particles together. Actually, its action on concrete is more comparable with puddling than with tamping.

With hand puddling, the mass of concrete is put into a quaking condition which denotes suspension of particles and plasticity. Vibration has a similar action. This is most apparent when vibration is applied to a dry, rocky, crumbly mix. If the mix is such that it can be compacted by vibration, the coarse particles will become "floated" in the mortar, and the mix becomes plastic during vibration.

The function of vibration is thus seen to be one of creating a state of plasticity which will allow the mix to flow or settle into place. With the plasticity induced by vibration, less mortar is required to produce a plastic mass than is required without vibration. The added energy causes a more complete suspension of particles in the mortar and thus makes an originally dry, semi-plastic mortar much more mobile.

In the light of the foregoing, it is seen that a vibrator cannot be prejudged on the basis of experience with slow-speed or non-rhythmic tools. Any of the vibrators that the writer has seen will impart some vibration to concrete, but all have their limits. In general, the less workable the mix, the more vibrators are required to handle concrete at a given rate. For any particular machine and placing condition it is necessary to determine the limits by trial, and to design the workability of the mix to fit the vibrator.

As an example of a method of judging the value of a particular machine on a given job, field tests may be cited, which were made last year on a vibrator of the internal type to compare its placing capacity with hand placing. Comparisons were made on the basis of the relative amounts of cement required to produce concrete having 5½ gal. of water per sack of cement. Tests using both vibration and hand placing were made under identical conditions. Mixes were adjusted for each method so as to require the full time of each crew when placing at the rate of 48 cu.yd. per hour. The final result was concrete free from honeycomb in both cases. The cement requirements are tabulated below:

Placing Method	Cement Required Sacks per Cu. Yd.	Per Cent Sand in Aggregate	Men Required
Hand puddling ...	6.04	39	6
One vibrator	5.10	31	2
Two vibrators	4.80	31	2*

*Two men were required for one vibrator, but the same men could handle two vibrators.

It is apparent from the above figures that two vibrators would have permitted a considerable economy on this job. The use of one vibrator made possible a saving of 0.94 sacks of cement per cu.yd. and the labor of 4 men. Adding a second vibrator would have effected a further saving in cement of 0.3 sacks, although no further saving in labor. This represents a possible saving of from 40 to 60c. per cu.yd. If the daily output were 350 yd., the vibrators would earn between $140 and $210 per day. By taking into account the cost of the vibrators and their maintenance, and the small addition to the cost of aggregate (about 5 per cent), the net saving could be computed.

In this case it might seem that 3 or 4 vibrators would have given even greater saving. However, further reductions in cement and water content were impracticable because drier mixes could not be discharged from the bottom-dump buckets in which the concrete was transported, and the internal vibrators would have left holes in the concrete upon withdrawal of the vibrating element. It is apparent also that as the second vibrator was of much less value than the first, the third or fourth might not even pay for themselves.

Under other conditions the results might be more or less favorable to the vibrator. The important point is that only by systematic observations can the actual worth of a vibrator on any particular job be determined.

It should be emphasized that the value of vibration does not lie alone in the possible saving in cement as outlined in the above illustration. There are structures in which the use of high quality concrete would effect considerable economies if the structures were designed on the basis of such concrete. As brought out earlier, vibration should make practicable the production of extremely high-quality concrete with an even lower shrinkage factor than for ordinary concrete. In addition, the importance of the use of vibration in placing concrete under difficult conditions where hand placing sometimes fails can scarcely be overemphasized.

Conclusion

In the light of information now available, vibration should be considered as a mechanical means of placing which has the potential possibility of producing a concrete superior to the best that can be produced by hand placing. It also aids in placing concrete under difficult conditions and will permit the production of concrete of ordinary quality with less cement.

There is still much to be learned about the mechanics of vibration itself and of the most effective method of applying it under field conditions. At the present time no one can state definitely, on the basis of scientific data, the proper method of application or intensity of vibration which is best suited to any particular job. On the other hand, available equipment, when used with judgment and common sense, is now producing gratifying results under a variety of conditions.

Vibrated concrete does not differ fundamentally from hand-placed concrete. The water-cement ratio is the chief factor determining its quality, providing that complete envelopment of the aggregate in the paste is effected. The benefits to be derived must, therefore, come from greater efficiency in placing under adverse conditions with a saving in labor cost, or from improvement in quality or saving in cost of cement through adjustment of the mix.

River Gages Improved With Public-Works Fund

NEW river gages will soon replace many of those used by the United States Weather Bureau for 25 or 30 years in recording the rise and fall of water in the more important streams. Information on river stages thus obtained serves as the basis for federal flood forecasts and warnings and also guides navigators in setting their schedules and dry-land farmers in opening or closing their irrigation ditches.

Each of the 34 states concerned has just been allotted a share in the $150,000 from the federal public-works fund set aside for repairing river gages. The amounts range from $1,000 for New Jersey to $10,000 for Texas. The immediate replacement thus made possible, says M. W. Hayes, chief of the river and flood division of the Weather Bureau, removes all need for expensive and unsatisfactory tinkering with about 200 gages that have been buffeted by drifting logs and breaking ice until they are practically beyond repair. At the same time, he points out, it will bring about relief in the unemployment situation.

The 650 gages with which the Weather Bureau watches water stages at strategic points along rivers are of two general types—the measuring staff, which comes in various forms and is set up in many ways, and the self-recorder.

The vertical gage, the inclined gage and the suspended gage are perhaps the most common of the first type. A vertical gage is a graduated scale attached to a bridge pier or to a cluster of piles driven into the bed of a stream. An inclined gage is made by setting in concrete, along the slope of the river bank, an iron beam graduated in vertical feet and tenths of a foot. A weight gage is made by attaching a weight to a wire or chain and hanging it from a bridge rail.

A recorder consists of a float in a pipe or a concrete well on the river bank. The river water enters the pipe or well through openings, and the float rises or falls with the river's fluctuations. Attached to the float is a wire that runs over a drum to move a pen which traces the rise and fall of the water on a sheet moved by a clock.

Two Railroad Bridge Failures Laid to Inadequate Inspection

I.C.C. Safety Bureau holds undermining of pier on Anacostia River Bridge near Washington, D. C., and washing out of abutment on bridge in New Mexico could have been avoided

LACK of adequate supervision and inspection of the bridge structures is stated by W. P. Borland, director of the Bureau of Safety of the Interstate Commerce Commission, to be the reason for two bridge accidents that occurred late in August, one on the Pennsylvania Railroad near Washington, D. C., and the other on the Southern Pacific Railroad near Hargis, N. M. (*ENR*, Aug. 31, 1933, pp. 270 and 271). Both bridge failures caused derailment of the train, loss of life and injury to passengers and crew.

Anacostia River Bridge

The accident on the Pennsylvania Railroad occurred on Aug. 24 where the railroad crosses the Anacostia River about 4 miles north of Washington, D. C. The bridge is a four-span deck plate-girder on a 46-deg. skew, built in 1904. It is the conclusion of the Bureau of Safety that settlement of the center pier under the train precipitated the derailment.

The abutments and piers were constructed of ashlar masonry superimposed on a concrete subfoundation, which in turn rested in a gravel stratum having a minimum depth of 7 ft. at midstream. The subfoundation penetrated this gravel about 2 ft.

The gravel was firm and was accepted by the engineers as capable of supporting double the load of 2 or 2½ tons per sq.ft. that the bridge would place on it. Over the gravel was a layer of mud about 8 ft. deep. Under normal conditions the stream had a depth of from 3 to 4 ft. at mean low water, while the tide range was about 3 ft.

A tropical storm had prevailed on Aug. 23, accompanied by unusually heavy rainfall, and it was still raining when the accident occurred about 3:30 a.m. on Aug. 24. Trackmen and track supervisors had crossed the bridge during the evening, either on foot or on trains, and had not noticed anything abnormal other than the high water, which was about 4 ft. below the tops of the piers.

The railroad company had no record of soundings taken at the brideg between the time it was built in 1904 and the time of the accident. The center-line profile at the time of construction is shown in Fig. 1. Soundings made by the U. S. Engineers in September, 1928, a few weeks after a storm of unusual severity, showed that substantial filling in had taken place north of the center pier, but between the center and south piers, where formerly there had been very litle water, there was a scour having a maximum depth at mean low water of 5.4 ft. Soundings made by the U. S. Engineers six days after the occurrence of the accident showed that the streambed had been scoured out very

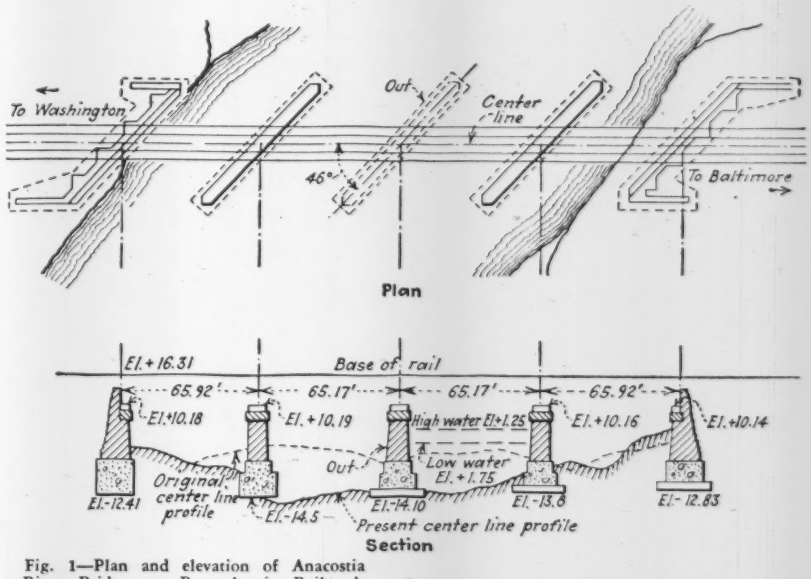


Fig. 1—Plan and elevation of Anacostia River Bridge on Pennsylvania Railroad, which collapsed due to scour under center pier.

badly since the 1928 soundings were taken; the maximum variation was at the north side of the center pier, where in 1928 the streambed was about 1½ ft. above mean low water, whereas six days after the accident it was 15 ft. below mean low water, or much more than sufficient to undermine the center pier. It also was found that the scour noted in 1928 between the center pier and the south pier had been extended until it reached a point more than 12 ft. under mean low water. According to the bureau's report, the evidence indicates that the water in the storm of Aug. 23 had been impounded above the bridge until it was considerably higher than the water below the bridge, and the head of water thus produced, operating through the comparatively narrow bridge opening, undoubtedly accounted for much of the scour that took place.

The only artificial change reported for the river since the bridge was constructed occurred downstream and consisted in widening the old 100-ft. channel to 300 ft. and giving it a maximum depth of 6 ft. According to the representatives of the U. S. Engineer office, this channel dredging was carried to within 50 ft. of the downstream end of the piers. The report states that there is no positive evidence that this dredging contributed to the failure, "and even so it was the duty of the railroad company to keep informed concerning changes that might have any effect on the safety of its bridge and to take such precautions as were necessary under the circumstances."

Railroad company engineers stated that while periodic inspections of the bridge structure and of the piers had been made, none of them had been carried below water level, since no cracks or settlements had indicated that unsafe conditions were developing. Because of the lack of soundings taken subsequent to 1928, the Bureau of Safety was unable to determine whether all of the undermining was done in the storm of Aug. 23 or whether it had been developing progressively.

In its conclusion, the bureau points out that periodic soundings taken at the bridge site immediately after the occurrence of flood conditions would have revealed any progressive development of scour and might have prevented the accident. The bureau further emphasized that the bridge inspection rules of the American Railway Engineering Association call for such periodic examinations.

Bridge failure in New Mexico

The bridge failure and passenger-train derailment on the Southern Pacific Lines occurred on Aug. 29 between Hargis and Tucumcari, N. M. It, too, was caused by floodwaters which in this case undermined an earthfill supporting

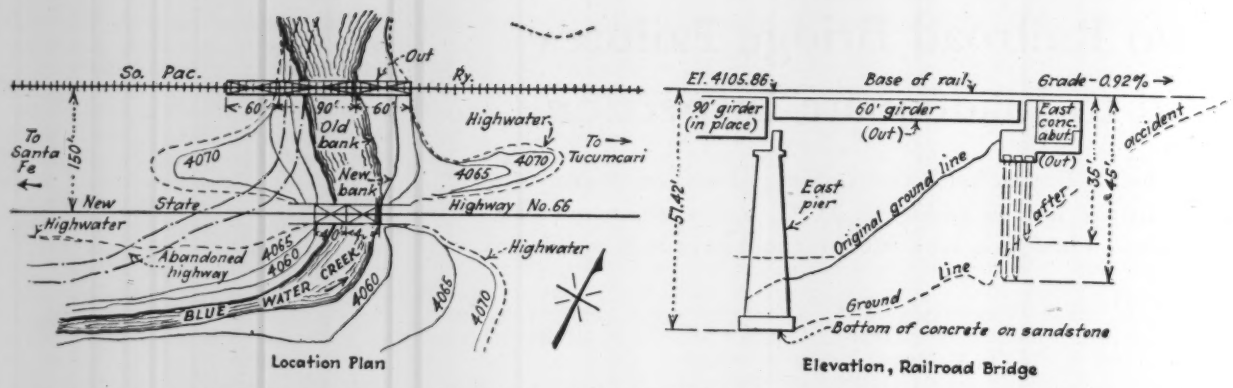


Fig. 2—Plan and elevation of bridge on Southern Pacific Lines in New Mexico, which collapsed when cast abutment washed out. Position of adjacent highway bridge was held to be a contributing factor to the accident.

the east abutment. The bridge, of deck plate-girder type, is shown in Fig. 2. It is paralleled upstream by a highway bridge built in 1931, consisting of two 40-ft. spans supported on a pier in mid-stream and by U-type abutments on each bank, all of reinforced concrete on rock foundations. There is a clear opening under the highway bridge 75 ft. wide and about 36 ft. deep. The center line of the highway bridge pier is 6 ft. west of the center line of the east pier of the railroad bridge, the result being that the flow of water under the highway bridge was directed against the east bank of the stream and the fill between the east pier and the east abutment of the railroad bridge.

On the night of the accident the water passing under the highway bridge reached a maximum depth of 26 ft. and about 24 ft. under the railroad bridge.

About 4:20 a.m., while a passenger train was passing over the bridge, the east abutment settled under the weight of the engine, causing collapse of the eastern span and the end of the abutment and the derailment of the tender and first five cars of the train. The sixth car fell over the north side of the bridge into the streambed, practically opposite the middle span of the bridge.

In its conclusions, the Bureau of Safety of the I.C.C. states that "There were three principal conditions which contributed to the failure of this bridge —namely, very heavy rains resulting in an extraordinary amount of floodwater in Blue Water Creek; the position of the highway bridge, which increased the velocity of the current and probably directed it against the railroad embankment; and the fact that the railroad embankment had not been protected against erosion.

The evidence of engineers who testified in this investigation is convincing that the failure of this bridge could have been guarded against by riprap, wing walls or other similar protective devices. The need for such measures at this point had existed since the construction of the highway bridge in 1931, and had a comprehensive survey been made by competent railroad engineers, the changed hydraulic conditions at this point, as a result of the construction of the highway bridge, should have been recognized. Furthermore, it was brought out in the investigation that as a result of rains earlier in the month of August the east bank of the stream between the bridges, as well as the toe of the fill near the east pier, had been washed away to an extent clearly indicating the need for protection of the railroad embankment. A number of local residents and users of the highway were aware of this condition and recognized the possibility of danger to the railroad; however, the railroad company had not made sufficiently frequent or thorough inspection to discover this condition; and because of this failure to discover and heed the warning given by the partial washing away of the embankment earlier in the month and to provide the protection which was then urgently required, the railroad company failed in the performance of its duties to the traveling public.

"This investigation indicates the need for closer cooperation between engineers of the railroad company and the state highway department with respect to construction of highway bridges near railroad bridges or structures, and the necessity for railroad engineers to keep currently informed in regard to changes which may affect safety of railroad operation resulting from construction or other developments adjacent to their rights-of-way."

Letters to the Editor

Free Engineering Services

Sir—Just having read the proposed engineers' code, I am very much in doubt about the practical results of certain provisions. In my opinion it will be necessary to eliminate and clarify some parts of this code in its final form, to avoid serious obstacles to the professional consultant engineer and to prevent a grave injustice to a large number of engineers that are engaged in other engineering activities.

The proposed code requires that a professional engineer shall not "specify, direct, invite or accept engineering designs, studies or sketches from a contractor, subcontractor or supplier of materials, interested in the work or in bidding on any element of the work where such are services herein defined, or defined in his agreement with his client or employer, as being the responsibility and duty of the engineer. This does not debar the customary shop and working drawings, made by the contractors for the work executed by them, nor the use of technical trade information issued by producers for the information of the engineer."

This stipulation is decidedly unfair to the large group of engineers who are owners or directors of contracting or manufacturing firms specializing in the various branches of engineering construction and supplies, and most of all to the professional engineer's client or employer. Under this provision of the code, the practicing professional engineer is deprived of the most valuable assistance that he is now enjoying, to coordinate design and building of his structures to the best interest and advantage of his client. In the design of power plants, bridges, waterworks, reduction plants, factories, and especially in the different branches of maritime-engineering structures such as seawalls and other shoreline protection work, the engineer does and must always depend upon such specialists to provide him with plans, sketches and specifications, in order to create structures that embody the most advantageous features at the lowest possible cost.

Take, as an example, the design and construction of a modern power plant. Shall the engineer be compelled to design his own boilers, turbines, economizers, pumps, generators, coal-handling machinery and the like? Shall he

not be permitted to invite plans, sketches or specifications of the specialists' organization who furnish these upon request, as a part of their sales service?

Or, take as another example, the building of seawalls, bulkhead walls, groins, jetties and similar coast and shore-line protective works. Is it not decidedly to the best interests of the engineer and of his client to invite competitive designs from specialists in this line of work? How many local consulting engineers have been able or had the opportunity to obtain the requisite experience and knowledge in this particular and extremely intricate class of engineering work, needed to design and actually build such structures? Is it not to the decided interest of the project engineer and of his client that there should be engineering and contracting organizations specializing in this class of work? That such firms, after many years of practice and at a great expenditure of money for investigation, research and experiments, have developed safe and economical types of such structures, which in many years of service, have been demonstrated to meet the requirements on approved engineering principles in a highly satisfactory and superior manner?

Why then should the engineer not be glad to "specify, direct, invite and accept" from these specialists such suggestions, designs, sketches or studies, in order to obtain for his clients the best possible results? Is it not to his own advantage and protection if he is thus able to entrust the work to experienced builders?

This holds equally true in all the other branches of engineering and construction work. We must recognize the fact that modern engineering has become exceedingly complicated on account of the incessant changes, additions and improvements to materials, methods and machinery developed and introduced by specialists, often at great cost and after years of special studies and investigations, in order to increase the safety and efficiency, and to reduce the cost of engineering structures and appliances. We must also realize that many of these firms are organized and managed by high-class professional engineers who maintain an engineering corps as designers, constructors and salesmen, and that their work cannot be performed except by their own well-trained construction departments.

Engineers everywhere are bitterly opposed to the so-called "free engineering service" by certain firms of specialists, and I am decidedly in favor of eliminating the evil side of this practice. The reason why "free" engineering service is offered to owners by many construction firms is found in the fact that in many cases the consulting engineer considers any suggestion by such firms as an interference in his plans, whether or not the suggestion or plan is to the advantage of his client. Only great engineers are open-minded and watchful for new ideas and methods, and are glad to give them every consideration if such is to the advantage of the project matter, and usually this is the principal reason why they achieve fame and a superior practice. However, you would be surprised to find out how few real great and open-minded engineers you find if you approach them with any new methods or improvements of construction practice.

We must also primarily recognize the fact that the engineer's first and uppermost obligation is to safeguard the interests of his clients. It is their money that is invested in his work. This implies the duty that the engineer shall open every door and channel to progress and competitive design, so that the client may get the full benefit of all advantages and improvements that are available for his project at the present time. The client depends upon him precisely for this service and does not care whether such improvements are offered by engineers, contractors or material suppliers.

There is not and cannot be anything unethical in the project cooperation of the engineer and such contractors who are interested in obtaining the contracts or orders for his project if such cooperation is to the best advantage of the client's interests. It is this cooperation that has made the planning and execution of the great engineering masterpieces a possibility.

We never approach an engineer's client direct, unless the engineer suggests, requests or permits that we do this. We never perform any professional engineering, but always insist that our client engage the services of a consulting engineer, even after we may already have been awarded the contract for the work. If the owner refuses to do this, we ourselves engage a local professional engineer to make the necessary surveys, maps, and to check over the work progress and to form the connecting link between the owner and ourselves.

We must not fail to recognize the fact that many large and small projects are undertaken as the result of the efforts of contracting or manufacturing organizations that offer their cooperation and other inducements to financiers or to the public to make the projects possible. They must do this with preliminary plans, estimates and other engineering data proving the feasibility, advantages and earning capacities for the project. Such propaganda and promotional service is always made entirely at the risk of the originators of the project which, if it is favorably received, immediately provides profitable work for engineers of all kinds and classes. Such work is not taking anything away from the professional engineer, but, on the contrary, it adds quite considerably to his sources of income. To outlaw, by the engineers' code, such preliminary work, which naturally must be charged to propaganda and sales expense, would be a grave error.

I fully appreciate the enormous difficulties encountered in the framing of an engineers' code that will be fair to all the different branches of the engineering profession, which not only embraces consulting engineers but also professional engineers who are actively engaged in the manufacturing and contracting field, and as promotional, sales and advertising experts. All these engineers are of equal importance to the nation, and they all must be given fair and just consideration in an engineers' code, for the reason that only by closest cooperation of these different activities can engineering progress be assured and maintained.

CARL WEBER,
President,
Shore-Line Builders, Inc.

Jacksonville, Fla.,
Oct. 14, 1933.

Synchronous-Motor Lift Bridges

Sir—In my article on lift bridges in your issue of Oct. 5, 1933, the calculations give the required coefficient of friction in terms of the vertical load. I wish to correct these calculations to express the necessary coefficient, using the total grip on the sheaves.

The total grip, or total load on sheaves in line with the radii of sheaves, is

$1{,}000{,}000 \times 3.14 = 3{,}140{,}000$ lb.

The available rack tooth force from an 80-hp. motor, using one-half specified values for friction of machinery, is

$$1{,}750 \times 125 \times .91 - \frac{41{,}000}{2} = 179{,}000 \text{ lb.}$$

The coefficient of friction necessary to lift the load is

$$\frac{179{,}000}{3{,}140{,}000} = 6 \text{ per cent.}$$

It is the belief that creeping will occur when the lifting coefficient is approached.

W. L. SIX,
Contracting Engineer,
The Mt. Vernon Bridge Co.

Kansas City, Mo.,
Nov. 17, 1933.

Traffic Volume in Stadium Exits

Sir—In your issue of Aug. 17, 1933, p. 200, there is an article entitled "Survey of Traffic Volumes Through Building Exits" by H. B. Houghton and J. H. Courtney. For my own information and with the aid of a number of students in the graduate school of engineering I have conducted a count of traffic flow down the concrete stairways at the Stanford Stadium at two of the football games this fall. These stairs are 8 ft. wide with a rise of 5¾ ft. and a tread of 12 in. The vertical height is 32 in. We found that the maximum number of persons discharged per foot of width per minute varies from 18.4 to 24.8. The travel on these stairways was down.

O. H. TUCKER,
Engineer, Stanford Board
of Athletic Control.

Palo Alto, Calif.,
Nov. 14, 1933.

Engineering News-Record

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A Jurisdictional Dispute Ended

QUICK SETTLEMENT of jurisdictional disputes, the most needless and exasperating of all labor troubles, is in prospect because of a decision of the National Labor Board last week, which in one specific dispute eliminated the warring labor factions from consideration and authorized the contractor to assign the disputed work to whichever trade he might select. Prior to this decision, work had been held up on federal buildings in Washington and Pittsburgh by petty squabbles over trade jurisdiction. Similar delay was threatened on the Philadelphia post office, and in this instance the dispute led the board to formulate its necessary, though long-delayed, ruling. Under its terms, labor is not deprived of the right to settle disputes by its own efforts or by arbitration; in fact, it remains labor's duty to bring about such settlement of jurisdictional differences. But when labor fails to carry out this duty, the case may now be taken out of labor's hands in order that the progress of construction shall not be stalled. The board's decision means that the spectacle of men being deprived of much-needed wages while two trades bicker over which shall perform a certain task will no longer be tolerated in this time of stress—nor, we trust, in future normal times.

PWA Allotments

ON DEC. 1 there remained unallocated but $438,000,000 of the $3,300,000,000 public-works fund. The President is expected to ask Congress for more money to continue the PWA work, but before Congress acts depletion of the fund may hold up many worth-while municipal projects. For that reason there is good cause to recommend to the Public Works Administration that it examine some of the allotments already made with a view to cutting them down to something near what can be spent during the year 1933. Large items on the list appear to be far in excess of next year's requirements. Among them are allocations of $100,000,000 to the Federal Housing Corp., $50,000,000 to the Tennessee Valley Authority, $12,200,000 to the Casper-Alcova irrigation and power project, $15,000,000 to the Grand Coulee power project (already cut from $63,000,000), $20,250,000 to Bonneville Dam, $25,000,000 to Fort Peck Dam, $44,200,000 to the Triborough Bridge, and $37,500,000 to the New York midtown tunnel. On no one of these projects can the total amount now allocated be converted into jobs during the next year. All that should be allocated to them is sufficient to cover the necessary commitments to keep the work going at top speed on the assumption that Congress ultimately will provide money to see the work completed. Many lesser allotments, such as the millions for defensive works in Hawaii, likewise should be reviewed and reallocated if necessary. The purpose of the PWA fund was not to finance long-time operations but to supply funds to counteract the falling off in current construction expenditures and bring about present, not future, re-employment.

Vigilance the Price of Safety

FINDINGS of the Bureau of Safety of the Interstate Commerce Commission as the result of an inquiry into two recent railroad accidents are of special interest because in both cases the bureau concluded that the accident might have been avoided by alertness on the part of the maintenance forces in detecting dangerous change in physical conditions at the bridge. At one bridge, soundings that might have revealed scour around the piers never were taken by the railroad engineering forces even after the channel below the bridge had been materially altered by dredging. In another case a small but significant amount of erosion of the bridge approach fill, caused by channel changes made in relocating a highway close to the bridge, went unobserved by railroad men, although it was sufficiently evident to be noticed by natives of the region. Every railroad of any importance has rules calling for constant inspection of track structures by the maintenance forces and periodic inspection by the engineers. It is true that with well-built structures the chance of a dangerous condition developing is rare, and perhaps for this reason systematic inspection often becomes a formality, especially when the engineers and track supervisors are pressed by a multitude of what appear at the moment to be more urgent duties. Yet the accidents here noted serve to re-emphasize the oft-stated truth that safety is secured only through eternal vigilance.

Too Little Cooperation

OF THE TWO railroad accidents noted above, the one in New Mexico turns the spotlight upon a condition that is found all too frequently where railways and highways are built on adjoining rights-of-way. In many instances the construction of new routes, changes in alignment or new structures on one have an important bearing on the other, yet not always is an effort made to forestall harmful effects through consultation or co-operative action. In the New Mexico accident a new highway bridge, built in what appeared to be the best location in so far as the highway alone was concerned, directed the floodwaters of the stream against the railroad embankment, but the state highway authorities failed to take the matter up with the railroad engineers, nor did the latter give heed to the changed stream conditions even after the bridge was built. Like instances of the creation of unfavorable or dangerous conditions through lack of cooperation between highway and railway authorities have occurred elsewhere, and though no law requires such cooperation its absence is a ready source of trouble. The engineer's responsibility manifestly goes beyond the work in hand. It extends to its lasting effects in service, and requires that he foresee and control future hazards arising from his work.

Advancing Highway Requirements

CONTINUED betterment of our highway systems makes advisable an occasional pause to view the old in the light of the new as a means of appreciating the advance and charting the course for future progress.

An excellent example of the changes from fifteen years ago is to be had in the recently completed Ridge Route Alternate road of the California division of highways. The old ridge route has for many years been an important link in the state highway system leading over the Tehachapi Mountains on the main thoroughfare between Los Angeles and the interior valley to the bay region. It may be looked upon as a representative sample of the highway building of an earlier period, when traffic conditions and highway funds determined the 70-ft. curve radius of the old highway, among other features. Piecemeal improvement of the old highway sufficed for a few years, but in time growing traffic volume and speed made necessary (and gas-tax funds made possible) a major change involving complete relocation. An analysis of the benefits of the new route based on actual money saved to users, as given in this issue, provides an interesting comparison of the new and old in highway design and construction.

Winter Work Lags

APATHY in undertaking winter work is clearly indicated by the repeated notices from the bureaus of the Public Works Administration urging activity in writing contracts for and enforcing construction during the coming winter. Reluctance on the part of constructors to face cold-weather conditions was to be expected, for hibernating from November to April is the old-established custom. Working in the cold is not pleasant, and frost increases the difficulties and costs of many operations. Contractors who bid warm-season prices see a loss in winter operations; those who bid cold-weather prices see an added profit in postponement if it can be contrived. It is therefore plain that winter work can be assured only through insistence by the directing agency, else the constructor will avoid undertaking it.

If contractors are to be active agencies in prosecuting work and giving employment during the coming four months, they must be spurred to the task. That this is not being done seems evident from the facts. A survey of 110 jobs in some 30 states by *Engineering News-Record* indicates that in road work about 40 per cent of the contractors who were awarded work in late September and in October are planning to continue work actively this winter. In bridge work for roads the figure is about 48 per cent, and in heavy construction generally it is about 43 per cent. These figures have the inaccuracy of all straw-vote counts, but general observation supports their indication that contract construction is not voluntarily planning for a winter campaign.

The task of getting contract construction under way and keeping it active during cold weather rests squarely on the public-works officials under whom the direction of the work comes. Winter work requirements must be written into the contract, and the terms of the contract must be enforced. At the same time the contractor must be considered entitled to winter prices. If this is done, winter work can be widely undertaken and carried through successfully. Past experience gives complete proof of this fact.

In the light of this situation, active prosecution of PWA construction this winter is seen to be definitely an administration problem. No problem of construction technique lacks means of solution. The contractor *can* build in winter if he is *made* to build in winter and if he is paid the reasonable additional price that cold-weather construction justifies.

A Fundamental Issue

AN ISSUE that threatens to destroy the effectiveness of the engineers' code has been raised by the "engineer-constructors"—the name assumed by the firms and corporations that for years have made a practice of doing both the engineer's and the general contractor's work on large engineering projects. The engineers' code calls for a separate charge for engineering services in any work where other services are combined with engineering services. This provision is included to make it clear to the client that there is no such thing as "free engineering service." The engineer-constructors are opposed to segregating their charges for engineering services from those for other services and seek exemption either through a special provision in the engineers' code or by being set up as a separate group under the basic code.

Either position is untenable if the independent consulting engineer is to continue to exist; and there is every reason of public interest why he should continue to exist and flourish. His practice now is endangered, on the one hand, by the "free engineering" that manufacturers of equipment and special products offer clients to induce them to buy their wares, and, on the other hand, by the unscrupulous and generally low-grade practitioners who hire engineering brains at ridiculously low wages and who, through such exploitation, cut fees below those of the consultant who maintains an adequately-paid staff. The engineers' code aims to rectify both these conditions. By requiring that fair wages be paid and that employee service be made as continuous as possible it aims to end fee cutting through exploitation. By requiring that the actual cost of engineering services and a reasonable amount of overhead be billed as a separate charge to the client for engineering services, it aims, first, to give him a clear indication that there is no such thing as free engineering services, and, second, to afford him an opportunity to evaluate the services of the producer of a special product who may be assumed to be prejudiced in favor of his own product against the services of an independent consulting engineer.

If the code is not to require that firms like Stone & Webster Engineering Corp. or the United Engineers & Constructors must state their engineering charges separately, the code might better be scrapped. We do not imply that these or other well-known firms of like character resort to unfair practices. But we hold that their high standards do not alter the fact that so far as they engage in engineering no exception can or should be made for them. Any exception made for them, either in the engineers' code or in a supplemental code, will throw the door wide open to the unscrupulous engineer to sidestep the requirements of the code by the simple expedient of calling himself an engineer-constructor.

Arguments in support of the demands of the engineer-constructors such as that of the difficulty of segregating engineering services simply serve to becloud the issue. Segregation of fees is essential if the competent and conscientious independent consulting engineer is to survive.

NEWS OF THE WEEK

More PWA Projects Transferred To Civil Works

ON Dec. 5 the Public Works Administration announced the transfer of 40 projects to the Civil Works Administration. These, with those transferred earlier in the week, bring the total for the week to 130 applications for loans for non-federal projects of a character regarded as more suitable for execution as civil works which have been transferred to the CWA.

Employment figures

The CWA reports as of Nov. 25, the end of the first week of operation, 1,183,267 persons as employed and Harry L. Hopkins, Civil Works Administrator, estimates that 800,000 were added during the second week ended Dec. 2. Federal projects approved to date contemplate assignment of 227,060 men, and include purification of water supplies by the Public Health Service by sealing abandoned coal mines, combatting the Dutch elm disease in New York, New Jersey and Connecticut by the Bureau of Plant Industry, exterminating the gypsy moth in New England states by the Bureau of Entomology, general repair, painting, landscaping and ground cleaning by the Navy and Veterans Administration, and an architectural survey of historical buildings throughout the United States.

Historic building survey

The plan for making an exact architectural record of buildings of historical value, including those of the Indians of the Southwest, proposed to the Civil Works Administration by Charles E. Peterson, chief of the eastern division of landscape and architectural planning of the Office of National Parks, Buildings and Reservations, has been adopted by the CWA as a means of furnishing relief for about 1,200 men of architectural training for a period of two or more months. The proposal embodies the securing of services of a qualified group of architects and draftsmen to study, measure and draw up plans, elevations and details of important antique buildings of the United States. The work can be put under way at once and is estimated to cost about $450,000. It is proposed to set up an advisory committee of seven men, four to be named by the American Institute of Architects, and three to be named by the director of the Office of National Parks, Buildings and Reservations to plan and direct the work. This committee will serve without pay, but will be reimbursed for necessary traveling expenses.

To promote the construction of airports as local projects, 250 men have been attached to the Aeronautics Branch of the Commerce Dept. as civil works employees. All airport projects must be approved by these supervisors before they are authorized by state civil works administrators. Sites may be municipally owned or leased but in the latter case must be for 5 years with option to purchase, and the municipality must agree to use the site for airport purposes only during that period. The program will also include landing fields that have no municipal backing but are regarded as necessary by the Aeronautics Branch.

Material costs under CWA

CWA's general rule with reference to the purchase of equipment and materials is that the cost shall not exceed 30 per cent of the total cost of the project. This will vary with the character of the project. Hand tools may be purchased but power equipment such as dredges, steam rollers and concrete mixers should be leased.

Construction League Holds Out For General Code Authority

The Construction League of the United States and the underlying organizations, in the discussion now in progress in Washington, are standing firm for a general code authority with divisional authorities for the various branches of the construction industry, also for a provision that regional agreements between truly representative groups on wages and hours should be binding on all employers and employees in the region. Instead of the League's code authority of 9 members, 3 representing design, 3 general contractors and 3 subcontractors, Donald Richberg of the NRA has proposed a code authority with two departments, 9 members representing building construction and 9 other branches. Mr. Richberg contends that regional agreements would bind only the signatories and he suggests a substitute provision that when such agreements are made by representative groups of employers and employees and approved by President Roosevelt, it shall be considered unfair competition if other employers or employees do not conform; burden of proof will be on them. For consideration of complaints against nonconformists Mr. Richberg proposes compliance boards with equal representation of employers and employees and an impartial chairman. The League's objections to Richberg's draft of the code were submitted to him Monday. A conference committee representing the League, the general contractors, subcontractors, labor, building trades employers and builders exchanges, and Robert W. Lea and Mr. Richberg met the NRA Wednesday.

International Road Congress To Be Held in Munich

The 7th International Road Congress is to be held in Munich, Germany, in September, 1934, on invitation from the German government. The Congress will extend from Sept. 3 to Sept. 7 after which a number of road inspection trips of from 8 to 10 days duration will be made through parts of Germany.

President to Ask New PWA Fund From Next Congress

APPROPRIATIONS to be requested by President Roosevelt to carry on the public works program will amount to about $1,500,000,000. Only $438,118,960 remains for allotment from the original $3,300,000,000 appropriated last spring and it is expected that this balance will have been exhausted by the time Congress convenes.

The probable amount of the new fund was revealed by Harold L. Ickes, Administrator of Public Works, following his return from Warm Springs Nov. 29. Asked whether the new appropriations would amount to $3,000,000,000, Secretary Ickes replied that "half that would be more likely."

Applications over three billion

The Public Works Administration previously had disclosed that pending applications for loans and grants for non-federal projects regarded as worthy of consideration total $3,100,000,000. Many of these will go by the board for one reason or another, Secretary Ickes remarked with reference to the fact that the new appropriation would cover only half of the pending projects.

Employment created

According to PWA's own estimate, its funds have put 2,993,360 men to work but this total includes 1,183,267 employed by the Civil Works Administration, 347,623 in the Civilian Conservation Corps and 695,246 stated to be employed indirectly in furnishing equipment and supplies for the Civilian Conservation Corps.

Employment created by the public works program proper thus totals 767,224, as follows: Directly on federal projects 248,571, indirectly 497,142; directly on non-federal projects 4,869, indirectly 9,738; and 6,904 on administrative payrolls of the Public Works Administration, National Recovery Administration and Tennessee Valley Authority. Indirect employment is estimated by multiplying by 2 the number of men directly employed.

Maine office closed

The Maine office of the PWA closed Nov. 30 due to lack of applications for loans in that state covering projects which may be financed wholly or in part by the PWA.

PWA has concluded that the proposal to create for the Columbia River basin an authority similar to the Tennessee Valley Authority, will require legislation. Besides the proposal of the Ickes board, Congress will also have to consider Senator Norris' plan to apply the same sort of administration to direct development of the Missouri River territory.

Henry G. Chapman has been appointed executive assistant to Henry M. Waite, Deputy Administrator of Public Works.

Mr. Chapman was associated with Col. Waite on the Cincinnati terminal job.

R. W. Rigsby, acting executive assistant of Col. Waite, has been named liaison officer between PWA and the Civil Works Administration to serve in the same capacity as William Zimmerman, Jr., previously appointed.

State quotas exceeded

With its funds running low, the Public Works Administration has adopted a more discriminating policy in distributing among the states allotments for both federal and non-federal projects. Secretary Ickes, on Dec. 5, revealed that nineteen states have exceeded tentative quotas representing amounts to which individual states are equitably entitled on the basis of population, unemployment and other factors. Secretary Ickes explained that these are not hard and fast amounts and this is illustrated by the fact that the excess quotas in most of nineteen states is large. Quotas also are variable, said Mr. Ickes, explaining that Arizona, for example, cannot properly be charged with the entire cost of Boulder Dam, as expenditures for that project reach back into a large number of states. The PWA will continue to consider on their merits all projects in states now over their quota. Mr. Ickes named the states which have exceeded their quotas as Arizona, California, Colorado, Delaware, District of Columbia, Idaho, Maryland, Montana, Nebraska, Nevada, New Hampshire, New Jersey, New Mexico, Oregon, Utah, Vermont, Virginia, Washington and Wyoming. Mr. Ickes declined to reveal the tentative quotas that have been assigned to these and other states, declaring this would only lead to misunderstanding.

Subsistence Homestead Corporation

Secretary Ickes, on Dec. 5, announced the organization of the Federal Subsistence Homesteads Corp. under a Delaware charter to make loans out of a $25,000,000 revolving fund to subsidiary local corporations established to select sites and erect homes on projects similar to the Reedsville, West Virginia, and Dayton projects now under way. Homestead projects aggregating $750,000,000 have been received by the PWA. Arrangements for the establishment of many local corporations are expected to be completed within two weeks.

Allotments announced Dec. 5 include $192,000 for river and harbor improvements in Washington state, $18,500 for air conditioning in the Geological Survey's map reproduction plant, and $470,000 to enable the New Orleans Public Belt Railroad Commission to comply with the award of the National Labor Board increasing the cost of its bridge construction.

Commenting on the rejection by the San Francisco Board of Supervisors of the bid of the City Company of New York, a syndicate of 30 bankers and bond houses, for $13,490,000 of authorized issue of $20,480,000, Secretary Ickes described as unconscionable the syndicate's demand for six per cent interest rate. Declaring that the city offers excellent security, Mr. Ickes said "the attitude of the syndicate which made this bid is to say the least one of non-cooperation in the recovery program. It is difficult to arrive at any other conclusion when even the banks say they are bursting with money."

Bridge Tower Design Prize Offered by Steel Institute

Prizes for the best designs for a steel tower of a small highway suspension bridge are being offered by the American Institute of Steel Construction, New York. This is the sixth annual bridge design competition held by the Institute for the benefit of students of architecture and engineering. The competition this year will be open to bona fide registered students of structural engineering and architecture in recognized technical schools of the United States and its possessions. A cash award of $100 will go to the winner of the first prize and a cash award of $50 to the winner of the second prize. Certificates of award will go to those whose designs are placed third, fourth and fifth.

The competitors are asked to submit a preliminary rendition by March 3, 1934. Main span of the supposed bridge is set at 500 ft., center to center of towers; the cable sag at mid-span 60 ft.; side spans each 240 ft. from center of towers to anchorage conections; clear roadway width of 30 ft.; elevation of the underside of roadway at towers would be 50 ft. above water level, and top of masonry piers 10 ft. above water level. Only students registered for this current school year may compete and all renderings are to be line drawings in black only, color or wash being prohibited.

From the preliminary renditions the ten best will be selected at a preliminary judgment to be held on March 20, 1934, and the students asked to submit final drawings which will be judged on May 3 for the prizes.

JAMES H. MacDONALD TWICE HONORED FOR HIGHWAY WORK

James H. MacDonald, highway consultant, New Haven, Conn., and head of the Connecticut state highway department from 1895 to 1915, was honored by the people of the state of Connecticut on Sept. 6 when the monument shown in the accompanying photograph was dedicated on Avon Mountain in the new Connecticut state park bearing Mr. MacDonald's name. In the accompanying photograph Mr. MacDonald stands at the right, next to him is Governor Cross and at the left is John A. Macdonald, highway commissionet.

James H. MacDonald was one of the founders of the American Road Builders Association and at the present time is treasurer of the organization. In speaking of him at the dedication ceremonies, Governor Cross said, "This is a memorial established by his contemporaries to remind oncoming generations of the high regard they have for him and for his engineering accomplishments. Mr. MacDonald brought science into roadbuilding and fought to release dirt roads from the thraldom of mud."

Recently the American Association of State Highway Officials, the American Road Builders' Association and the Highway Research Board announced that the George S. Bartlett Award is to be conferred upon James H. MacDonald at the annual meeting of the Highway Research Board in Washington on Dec. 7. The award is made in recognition of meritorious achievements.

Work Undertaken By Geodetic Survey as Relief Project

THE U. S. Coast and Geodetic Survey has undertaken supplemental control work throughout the entire country as part of the work to be carried out under the funds turned over to the Civil Works Administration by the Federal Emergency Relief Administration.

The purpose of the project is twofold: (1) to furnish employment during the coming winter to engineers and others as part of the drive toward economic recovery, and (2) to serve this purpose in a way which will be productive of results of a permanent public value. The control surveys (triangulation, traverse, and leveling) will be supplemental to the existing federal program which contemplates a network of permanently marked points whose geographic coordinates and elevations are accurately determined. These networks are to have a 25-mile spacing. They are being surveyed using money turned over to the U. S. Coast and Geodetic Survey by the Public Works Administration some time ago for the continuation of its operations. From the beginning, this project contemplated that other federal or state agencies in the course of their respective public works would establish additional points tied into the basic net. Thus there would be gradually developed an intensive monumentation of points throughout the country within reach of all engineering work.

The present project is to be of this supplementary character. The Coast and Geodetic Survey is now in the process of building an organization in each state to carry on the work and is selecting state representatives with the aid of American Engineering Council, the engineering societies and the engineering departments of the colleges and universities.

The state representative will organize and administer the work, will select the men to be employed, taking them from lists furnished by the state civil works administrators, having full authority to hire and fire as conditions warrant. He will organize and operate as many survey parties as practicable and one or more central offices where the results of the field work will be computed and adjusted in preparation for publication. In their final form, the results will be available in terms of plane coordinates with which all engineers are familiar, rather than the geodetic coordinates which are less useful because less readily understood.

Survey instruments sought

An important detail of the project is that instruments and equipment for the work must be furnished locally. To this end the Coast and Geodetic Survey is seeking the cooperation of members of the engineering profession who in view of the slump in engineering practice must have available instruments that can be loaned to the Survey for this work.

Engineers desiring employment on this project should register promptly with their state civil works administrator. A list of the state administrators is given in the table below. They should also advise the state representative of the U. S. Coast and Geodetic Survey that they desire such employment. The names of the representatives appointed to date also are given herewith.

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J. T. Donaghey, Chief Engineer of Wisconsin Highway, Dies

John T. Donaghey, chief engineer of the State Highway Department of Wisconsin, died at Rochester, Minn., on Nov. 30.

Mr. Donaghey was born in Wisconsin in 1867, and has been actively connected with highway development work there since the enactment of the county-aid highway law by the state legislature in 1907. In 1908 he was elected the first county highway commissioner of Sauk County. Following the enactment in 1911 of the state-aid highway law, Mr. Donaghey, in 1912, was appointed chief inspector for the state highway commission. He was appointed state highway engineer of the Highway Department in 1924. In 1927 Mr. Donaghey was summarily removed as highway engineer for what appeared to be a purely political reason, but subsequently was reappointed.

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The bridge, opened in 1926, was constructed with provision for the addition of a rapid transit line at some future date. The proposed line will be about 2 1/3 mi. long, extending from a connection with the Philadelphia Rapid Transit subway system at 8th and Race Sts. across the bridge to a terminal in the heart of Camden, about one-half mile from the bridge.

Aberdeen Proving Ground

An allotment of $2,947,150 was approved by the PWA last week for the construction, reconditioning and general improvement of the Aberdeen Proving Ground in Maryland. Extension of the air field will cost $627,000 and the remainder of the money will be spent on officers' quarters, barracks, a hangar, roads and repairs to the water system.

An allotment of $1,087,478 was made to the Aeronautics Branch of the Department of Commerce for the installation of lighted airways from Minneapolis to Seattle, from Fargo, N. Dak., to Pembian, N. Dak., from St. Louis to New Orleans and from St. Louis to Tulsa, Okla., and also on the Galveston-Houston-Waco route in Texas.

The Office of Indian Affairs, Department of the Interior, has been allotted

DETAILS OF PWA LOANS AND GRANTS FOR NON-FEDERAL WORK

Locality	Loan and Grant or Grant	Type	Man-Months Work Provided	Amount
Shippensburg, Pa. (amended)	G.	Water	45	$36,000
Ann Arbor, Mich. (amended)	L. & G.	Sewer	4,500	450,000
Anna, Ill.	L. & G.	Water supply	450	110,000
Lena, Ill. (amended)	L. & G.	School addition	360	47,600
Mandan, N. D.	L. & G.	Reservoir	270	49,000
Girard, Ill.	L. & G.	Waterworks	600	109,000
Rome, Ga.	L. & G.	Sewer	800	130,000
Providence, R. I.	L. & G.	Streets	1,080	158,700
Providence, R. I.	L. & G.	Streets	2,280	362,633
Providence, R. I.	L. & G.	Sewage	900	475,000
Delaware River Joint Commission	L. & G.	Rapid transit line	28,800	11,900,000
Virden, Ill.	L. & G.	Water supply	1,200	188,000
Geneseo, Kan.	L. & G.	Waterworks	360	49,000
Dunn County, Wis.	L. & G.	Building	100	50,000
Divernon, Ill.	L. & G.	Waterworks	400	63,000
Rome, Ga.	L. & G.	Waterworks	960	230,000
Bloomfield, Iowa (amended)	G.	Water supply	60	300
Stamps, Ark.	L. & G.	Water supply	135	42,000
Roseville, Ill.	L. & G.	Water	36	12,000
Westchester County, N. Y.	L. & G.	Sewers	14,400	2,100,000
Montevideo, Minn.	L. & G.	Sewer	350	73,000
Worcester, Mass.	L. & G.	Water	900	139,000
Longview, Texas	L. & G.	Sewage	160	42,000
Selmer, Tenn.	L. & G.	Waterworks	400	92,000
Lubbock, Texas	L. & G.	Dormitory	2,000	650,000
Ipswich, S. D.	L. & G.	Courthouse	240	85,500
Canton, N. D.	L. & G.	City Hall	15	3,040
Epping, N. D.	L. & G.	School addition	20	4,400
Florida Ferry Co., Jacksonville, Fla. (private)	L.	Bridge	3,000	1,310,000
Rochester, N. Y.	L. & G.	Sewers	3,060	660,000
Lexington, Mass.	G.	Water	180	11,000
Santa Maria, Calif.	G.	Municipal building	160	12,100
Cheviot, Ohio	G.	Sewer	170	7,700
State of Connecticut	G.	Road	525	42,000
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Santa Cruz, Calif.	G.	Waterworks	60	23,000
Kavai, Territory of Hawaii	G.	Water Improvement	360	21,300
State of Connecticut	G.	Road	375	21,400
Jackson County, Iowa	G.	School Improvement	3	1,000
Allegan, Mich.	L. & G.	Power Plant	2,200	410,000
San Luis Obispo, Calif.	G.	Sewers	120	9,000
Ventura, Calif.	G.	School Improvement	120	5,100
Aneheim, Calif.	G.	Power Transmission	288	15,000
Stillwater, Okla.	G.	Sewer	140	4,000
Longdale, Okla.	G.	School Improvement	4	280
Onandaga, N. Y.	L. & G.	Sewers	6,000	1,650,000
Cheviot, Ohio	G.	Sewer	40	3,000
Paynesville, Minn.	G.	Waterworks Impr.	10	1,000
Arapahoe, N. C.	G.	Community Bldg.	32	2,000
Newport, Ky.	G.	Building	220	13,000
Hanley Falls, Minn.	G.	Waterworks Impr.	18	2,000
State of Indiana	G.	Road Improvement	6,300	125,000
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Jackson County, Minn.	G.	Roads	375	16,000
Yellow Medicine County, Minn.	G.	Bridge	45	3,000
State of Indiana	G.	Road Improvement	3,000	61,000
Redwood County, Minn.	G.	Road Improvement	975	34,000
State of Indiana	G.	Road Improvement	3,500	74,000
State of Indiana	G.	Road Improvement	2,800	65,000
Temple, Texas	G.	Water Tank	50	15,000
Antioch, Ill.	G.	Water Tank	5	3,000
State of Missouri	G.	Roads	12,000	1,500,000
Chicago, Ill.	G.	Schools	27,000	1,326,000
Van Zandt County, Texas	G.	School	8	1,000
State of Indiana	G.	Road Improvement	5,600	122,000
Cincinnati, Ohio	G.	Hospital Addition	75	9,000
Davenport, Iowa	G.	Streets	15	2,000
State of New York	G.	Hospital Buildings	2,250	183,000
State of New York	G.	School Building	480	38,000
State of New York	G.	Hospital	7,440	668,000
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		Total	161,249	$26,543,053

Work Undertaken By Geodetic Survey as Relief Project

THE U. S. Coast and Geodetic Survey has undertaken supplemental control work throughout the entire country as part of the work to be carried out under the funds turned over to the Civil Works Administration by the Federal Emergency Relief Administration.

The purpose of the project is twofold: (1) to furnish employment during the coming winter to engineers and others as part of the drive toward economic recovery, and (2) to serve this purpose in a way which will be productive of results of a permanent public value. The control surveys (triangulation, traverse, and leveling) will be supplemental to the existing federal program which contemplates a network of permanently marked points whose geographic coordinates and elevations are accurately determined. These networks are to have a 25-mile spacing. They are being surveyed using money turned over to the U. S. Coast and Geodetic Survey by the Public Works Administration some time ago for the continuation of its operations. From the beginning, this project contemplated that other federal or state agencies in the course of their respective public works would establish additional points tied into the basic net. Thus there would be gradually developed an intensive monumentation of points throughout the country within reach of all engineering work.

The present project is to be of this supplementary character. The Coast and Geodetic Survey is now in the process of building an organization in each state to carry on the work and is selecting state representatives with the aid of American Engineering Council, the engineering societies and the engineering departments of the colleges and universities.

The state representative will organize and administer the work, will select the men to be employed, taking them from lists furnished by the state civil works administrators, having full authority to hire and fire as conditions warrant. He will organize and operate as many survey parties as practicable and one or more central offices where the results of the field work will be computed and adjusted in preparation for publication. In their final form, the results will be available in terms of plane coordinates with which all engineers are familiar, rather than the geodetic coordinates which are less useful because less readily understood.

Survey instruments sought

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High-Speed Line on Delaware Bridge Financed by PWA

THE Public Works Administration has authorized a combined loan and grant of $11,900,000 to the Delaware River Joint Commission, representing the states of Pennsylvania and New Jersey, for the construction and equipment of a rapid transit line across the Delaware River Bridge between Philadelphia and Camden. The allotment is subject to the completion of a satisfactory contract with the PWA and includes a loan of $10,000,000 and a grant of 30 per cent of the cost of labor and material, estimated at $6,347,000. The loan will be secured by 4 per cent general obligation bonds supported by revenues from the bridge.

The bridge, opened in 1926, was constructed with provision for the addition of a rapid transit line at some future date. The proposed line will be about 2 1/3 mi. long, extending from a connection with the Philadelphia Rapid Transit subway system at 8th and Race Sts. across the bridge to a terminal in the heart of Camden, about one-half mile from the bridge.

Aberdeen Proving Ground

An allotment of $2,947,150 was approved by the PWA last week for the construction, reconditioning and general improvement of the Aberdeen Proving Ground in Maryland. Extension of the air field will cost $627,000 and the remainder of the money will be spent on officers' quarters, barracks, a hangar, roads and repairs to the water system.

An allotment of $1,087,478 was made to the Aeronautics Branch of the Department of Commerce for the installation of lighted airways from Minneapolis to Seattle, from Fargo, N. Dak., to Pembian, N. Dak., from St. Louis to New Orleans and from St. Louis to Tulsa, Okla., and also on the Galveston-Houston-Waco route in Texas.

The Office of Indian Affairs, Department of the Interior, has been allotted

DETAILS OF PWA LOANS AND GRANTS FOR NON-FEDERAL WORK

Locality	Loan and Grant or Grant	Type	Man-Months Work Provided	Amount
Shippensburg, Pa. (amended)	G.	Water	45	$36,000
Ann Arbor, Mich. (amended)	L. & G.	Sewer	4,500	450,000
Anna, Ill.	L. & G.	Water supply	450	110,000
Lena, Ill. (amended)	L. & G.	School addition	360	47,600
Mandan, N. D.	L. & G.	Reservoir	270	49,000
Girard, Ill.	L. & G.	Waterworks	600	109,000
Rome, Ga.	L. & G.	Sewer	800	130,000
Providence, R. I.	L. & G.	Streets	1,080	158,700
Providence, R. I.	L. & G.	Streets	2,280	362,633
Providence, R. I.	L. & G.	Sewage	900	475,000
Delaware River Joint Commission	L. & G.	Rapid transit line	28,800	11,900,000
Virden, Ill.	L. & G.	Water supply	1,200	188,000
Geneseo, Kan.	L. & G.	Waterworks	360	49,000
Dunn County, Wis.	L. & G.	Building	100	50,000
Divernon, Ill.	L. & G.	Waterworks	400	63,000
Rome, Ga.	L. & G.	Waterworks	960	230,000
Bloomfield, Iowa (amended)	G.	Water supply	60	300
Stamps, Ark.	L. & G.	Water supply	135	42,000
Roseville, Ill.	L. & G.	Water	36	12,000
Westchester County, N. Y.	L. & G.	Sewers	14,400	2,100,000
Montevideo, Minn.	L. & G.	Sewer	350	73,000
Worcester, Mass.	L. & G.	Water	900	139,000
Longview, Texas	L. & G.	Sewage	160	42,000
Selmer, Tenn.	L. & G.	Waterworks	400	92,000
Lubbock, Texas	L. & G.	Dormitory	2,000	650,000
Ipswich, S. D.	L. & G.	Courthouse	240	85,500
Canton, N. D.	L. & G.	City Hall	15	3,040
Epping, N. D.	L. & G.	School addition	20	4,400
Florida Ferry Co., Jacksonville, Fla. (private)	L.	Bridge	3,000	1,310,000
Rochester, N. Y.	L. & G.	Sewers	3,060	660,000
Lexington, Mass.	G.	Water	180	11,000
Santa Maria, Calif.	G.	Municipal building	160	12,100
Cheviot, Ohio	G.	Sewer	170	7,700
State of Connecticut	G.	Road	525	42,000
State of Connecticut	G.	Road	525	46,000
Santa Cruz, Calif.	G.	Waterworks	60	23,000
Kavai, Territory of Hawaii	G.	Water Improvement	360	21,300
State of Connecticut	G.	Road	375	21,400
Jackson County, Iowa	G.	School Improvement	3	1,000
Allegan, Mich.	L. & G.	Power Plant	2,200	410,000
San Luis Obispo, Calif.	G.	Sewers	120	9,000
Ventura, Calif.	G.	School Improvement	120	5,100
Aneheim, Calif.	G.	Power Transmission	288	15,000
Stillwater, Okla.	G.	Sewer	140	4,000
Longdale, Okla.	G.	School Improvement	4	280
Onandaga, N. Y.	L. & G.	Sewers	6,000	1,650,000
Cheviot, Ohio	G.	Sewer	40	3,000
Paynesville, Minn.	G.	Waterworks Impr.	10	1,000
Arapahoe, N. C.	G.	Community Bldg.	32	2,000
Newport, Ky.	G.	Building	220	13,000
Hanley Falls, Minn.	G.	Waterworks Impr.	18	2,000
State of Indiana	G.	Road Improvement	6,300	125,000
State of Indiana	G.	Road Improvement	6,300	122,000
Jackson County, Minn.	G.	Roads	375	16,000
Yellow Medicine County, Minn.	G.	Bridge	45	3,000
State of Indiana	G.	Road Improvement	3,000	61,000
Redwood County, Minn.	G.	Road Improvement	975	34,000
State of Indiana	G.	Road Improvement	3,500	74,000
State of Indiana	G.	Road Improvement	2,800	65,000
Temple, Texas	G.	Water Tank	50	15,000
Antioch, Ill.	G.	Water Tank	5	3,000
State of Missouri	G.	Roads	12,000	1,500,000
Chicago, Ill.	G.	Schools	27,000	1,326,000
Van Zandt County, Texas	G.	School	8	1,000
State of Indiana	G.	Road Improvement	5,600	122,000
Cincinnati, Ohio	G.	Hospital Addition	75	9,000
Davenport, Iowa	G.	Streets	15	2,000
State of New York	G.	Hospital Buildings	2,250	183,000
State of New York	G.	School Building	480	38,000
State of New York	G.	Hospital	7,440	668,000
State of New York	G.	Hospital Buildings	3,600	255,000
		Total	161,249	$26,543,053

$1,562,500 for the construction of hospital facilities and $43,000 for remodeling and improving six existing institutions. The largest item is $250,000 for the state sanitorium at Walker, Minn.

A sum of $2,725,000 has been allotted to the Uncompahgre reclamation project in Colorado, the first constructed by the federal government, for the construction of the Taylor Park Reservoir, estimated cost $2,000,000, and for the improvement of the Gunnison Tunnel and for repairs to the existing canal system. The Taylor Park Reservoir will be formed by the construction of a dam 165 ft. high. It will hold 106,000 acre-ft. of water.

Construction of 55 post office buildings, all but one costing less than $100,000 and scattered over 23 states, has been provided for in an allotment of $3,089,190 to the Treasury Department. This raises the allotment to the Treasury Department for public buildings up to $60,000,000.

State and municipal projects

Seventy-one allotments for state and municipal projects, totalling $26,543,053 and with the allotment of $11,900,000 to the Delaware River Joint Commission included, were announced by the PWA on December 1. One loan of $1,310,000 to the Florida Ferry Company, a private corporation for the construction of a bridge, is included in the list.

Detroit housing

Secretary Ickes has taken strong exception to a letter sent out by the Detroit Housing Commission to the owners of property required for its project No. 3 in which the commission called attention to the fact that assessed property valuations are admittedly high and urged the property owners to "cash in" on the assessed value rather than attempt to obtain higher values. Secretary Ickes stated that no speculative values would be paid for property for housing development and that the PWA had not authorized the Detroit Housing Commission to make any commitments in its name.

Advisers named

C. Louis Borie, 3rd, of Philadelphia, has been named to the Pennsylvania State Advisory Board, PWA, to succeed A. T. Malmed; Delos F. Cosgrove, Watertown, N. Y., has been appointed a member of the New York State Board to succeed Peter G. Ten Eyck, resigned; and William B. Kelly, Stafford, Ariz., has been appointed to the Arizona State Advisory Board to succeed Leslie C. Hardy.

New 10-mill Tax Limit in Ohio Forces Cut in Columbus Work

The city of Columbus must cut off $3,445,450 from its eight-project public works program, according to the Ohio Tax Commission, which has notified city authorities that under the law and the recently adopted constitutional amendment limiting assessments on real estate to 10 mills on the dollar, only $6,895,950 of the $10.351,400 bond issue authorized at the Nov. 7 election can be legally made. The $2,588,100 of the federal grant will have to be decreased accordingly. City council has been called upon to decide which of the eight projects will be dropped. Legality of the bond issue also is in question.

SOCIETY CALENDAR

AMERICAN ROAD BUILDERS ASSOCIATION, annual convention, Chicago, Jan. 22-26, 1934.

AMERICAN SOCIETY OF CIVIL ENGINEERS, annual meeting, New York, Jan. 17-20, 1934.

AMERICAN TOLL BRIDGE ASSOCIATION will hold its annual convention at Cincinnati, Ohio, Jan. 26-27.

ENGINEERING INSTITUTE OF CANADA, 48th annual general meeting, Montreal, Que., Feb. 8-9, 1934.

HIGHWAY RESEARCH BOARD, National Research Council, Washington, D. C., Dec. 7-8.

AMERICAN WATER WORKS ASSOCIATION will hold its annual convention at New York, June 4-8, 1934.

TEXAS SECTION, Southwest Water Works Association will hold a meeting in cooperation with the Texas State Department of Health and the City of Dallas, at Dallas, Texas, January 15-17.

NEW YORK SECTION, American Water Works Association will hold its regular mid-winter meeting at the Hotel Commodore, New York, on Dec. 28. The National Recovery Committee will meet at 10:30 a.m., preceding the regular noon meeting, at which time representatives of the State Engineer's Office and of the Washington Office of the PWA will be present to discuss loans and grants to cities for municipal work.

AMERICAN SHORE & BEACH RESERVATION ASSOCIATION will hold its annual meeting in the building of the National Research Council, Washington, D. C., on December 11. The morning session will include addresses by Major General Edward M. Markham, Chief of Engineers, U. S. Army, and Col. William J. Barden, senior member of the U. S. Beach Erosion Board, also a symposium on beach and shore problems. At the afternoon session there will be addresses by Frederick A. Delano, chairman of the National Planning Commission and F. E. Schmitt, editor of *Engineering News-Record*, also papers on both erosion and protection problems.

Dormitory Bond Issue Upheld

The Oklahoma Supreme Court has upheld the validity of a bond issue of $450,000 by the Oklahoma A. & M. College at Stillwater, Okla. The bond issue was authorized by the Legislature in 1931, but was attacked on the grounds that the bonds would be direct obligations of the state and hence were illegal as no state levy had been made for their retirement. The court ruled that the bonds would be a direct obligation of the school, to be retired by rentals and fees derived from the dormitory.

Wage Rate Set for Construction by Tennessee Valley Authority

Minimum wage rates for all construction operations to be carried out under its direction have been set by the Tennessee Valley Authority, effective Dec. 1. The rates correspond to the wage rates set by the Public Works Administration, but are higher than those set by the PWA for the southern zone, and somewhat lower than those set for the central zone. Although the Tennessee Valley lies partly in each zone, the rates will apply throughout the entire valley. On the work at Norris Dam on Cove Creek, the Tennessee Valley Authority consider that the unusual living conditions to be provided for the employees will more than offset the difference between its scales and those of the PWA for the central district.

Bid Call on All-American Canal Postponed Until December 20

Bids on the excavation of about 4,000,000 cu.yd. of earth and 500,000 cu.yd. of rock on the first section of the All-American Canal in southern California, which were to have been opened on Dec. 4, have been postponed until Dec. 20, according to an announcement from the Denver office of the U. S. Bureau of Reclamation.

New York Garbage Dumping Limit Extended by U. S.

The United States Supreme Court, on Dec. 4, extended until July 1, 1934, the period in which New York may continue to dump garbage at sea. The dumping of garbage at sea by the city of New York has been continued beyond the date previously set by the court, and the present decision is the result of action brought by the state of New Jersey to have the Supreme Court compel the city to comply with its order to build garbage incinerators and cease dumping at sea. The city pleaded inability to complete its incinerator construction program because of financial conditions.

The court further ordered the city to pay the state of New Jersey damages amounting to $2,160 for the benefit of districts which have filed evidence of suffering from the New York dumping, and on and after July 1 the city is required to pay to the state of New Jersey $5,000 a day for each day in which the dumping of garbage at sea is continued.

Chicago District Pledges Funds For Restudy of Sanitary Project

Before it will allocate additional PWA loans and grants to the Sanitary District of Chicago to complete its program of sewage disposal the Public Works Administration has advised the district that additional studies and surveys of all available processes and methods of sewage treatment should be made. As a result, the board of trustees on Dec. 1, passed a resolution affirming this view as desirable before committing the taxpayers to the repayment of the large loan necessary to complete the disposal works. Further, the trustees agreed to make the necessary appropriations in the 1934 budget.

Extensive studies, investigations and experiments looking toward improvement in the art of sewage treatment and reduction in cost have been made during the past two years of forced inactivity. The board feels that additional improvements and economies may still be possible.

Just what form the new investigation may take is uncertain but PWA authorities have discussed with the district officers the desirability of a report by a competent board of engineers on the experimental work, present status of the project, the district's policy and proposed plans as they relate to the present state of the art and possible advances during the life of the proposed work. Such a board would bring the work of the 1924 board of review down to date and would propose a schedule of activities in accord with all requirements of the situation as they now exist.

New Bids Called for Annex to Post Office at New York

The Treasury Department has called for bids to be opened on Dec. 27 for the construction of the superstructure of the annex to the main post office in New York City. As noted in our issue last week, all bids received on the earlier call have been rejected because of confusion arising over the possible violation of the President's Re-employment Agreement by one of the bidders.

Niagara Frontier to Study Sewage Disposal Plans

Thomas Parran, Jr., N. Y. State health commissioner, following a conference of engineers and city officials of the Niagara frontier in Buffalo, N. Y., has ordered a detailed study of two plans submitted for the disposal of untreated sewage discharged into the river. A study will be made by a committee of engineers and city officials to determine which of these two plans is the most desirable:

(1) The plan of the Niagara Metropolitan Sewage committee, providing for a district sewage disposal system at an estimated cost of $26,000,000.

(2) The plan of W. W. Young of Youngstown for a district system, patterned after the system in Westchester county, at an estimated cost of $18,000,000.

Personal

DONALD E. BONJOUR, formerly with the U. S. Engineers Office at Kansas City, Mo., has been appointed engineer in charge of government construction of river works in the U. S. Engineer Office at St. Joseph, Mo.

GEORGE K. LEONARD, formerly assistant chief engineer, State Department of Public Works, Lincoln, Neb., for the past ten years general superintendent for Woods Bros. Construction Co. at Lincoln, has been appointed an engineer examiner for the Public Works Administration at Washington, D. C.

A. STREIFF, in charge of the southwestern territory for the Ambursen Construction Co., with headquarters at San Antonio, Tex., has been elected a vice-president of the company. Mr. Streiff formerly was associated with the Fargo Engineering Co. He is a graduate of the Swiss Polytechnic Institute of Zurich.

Obituary

RICHARD W. WILLIAMS, a retired civil engineer, died at his home in Brooklyn, N. Y., on November 29, age 80 years.

JOHN B. BOTT, a retired engineer of the Pennsylvania Railroad Co., died at Greensburg, Pa., on December 3, age 87 years. Mr. Bott worked on construction projects for both the Baltimore & Ohio and the Pennsylvania railroads, and was connected with the construction of the Pennsylvania tunnels into New York City.

PROF. GEORGE H. BARTON, geologist and director of the teachers' college of science, affiliated with the university extension courses at Harvard University, died in his classroom of a heart attack on Nov. 25. He was born in Sudbury, Mass., 81 years ago, and graduated from Massachusetts Institute of Technology in the class of 1880. His early career was devoted to civil engineering in Hawaii, where he became an authority on volcanoes.

ALFRED BROOKS FRY, consulting engineer, Coronado, Calif., died there on Dec. 4, age 73 years. Mr. Fry was born in New York in 1860, and graduated from the engineering school of Columbia University. In 1887 he was appointed chief engineer for the U. S. Treasury Department in charge of the design and construction of the steam, electric and hydraulic plants in U. S. Public Buildings, and served in the Treasury Department until 1914, when he was appointed consulting engineer to the Department of Water Supply, Gas & Electricity in the City of New York to succeed Edward Wegemann. While in the federal service much of his time was spent in port work at New York. In 1904 Mr. Fry was appointed a member of the board of consulting engineers for the improvement of the New York State canals.

CONSTRUCTION STATISTICS OF THE WEEK

A SLUMP in federal awards, which were less than half the average of the past month, pulled the total of contracts let last week to the lowest in five weeks, $23,256,000. Highway lettings continued strong with $10,042,000 reported in contracts. Public works other than federal maintained the average of the past month. Private construction came back with a total equal to a month's average after a poor showing the previous week. Commercial buildings comprised more than half the private total, swelled by a single housing contract in New York amounting to $3,200,000. Other large contracts of the week included a state hospital at Orangeburg, N. Y., $1,023,000 and highway awards in Texas exceeding a million dollars. New productive capital issues of the week, amounting to over $26,000,000 were nearly all allotments by PWA.

CONTRACTS
(Thousands of Dollars)

	Weekly Average Dec. 1932	Prev. 4 Weeks	Week Dec. 7, 1933
Federal Government	$6,095	$10,119	$4,569
State and municipal	10,024	13,565	13,313
Total public	$16,119	$23,684	$17,882
Total private	4,553	4,694	5,374
Week's total	$20,672	$28,378	$23,256

Cumulative to date:
1932 ....$1,157,293 1933 ....$989,259

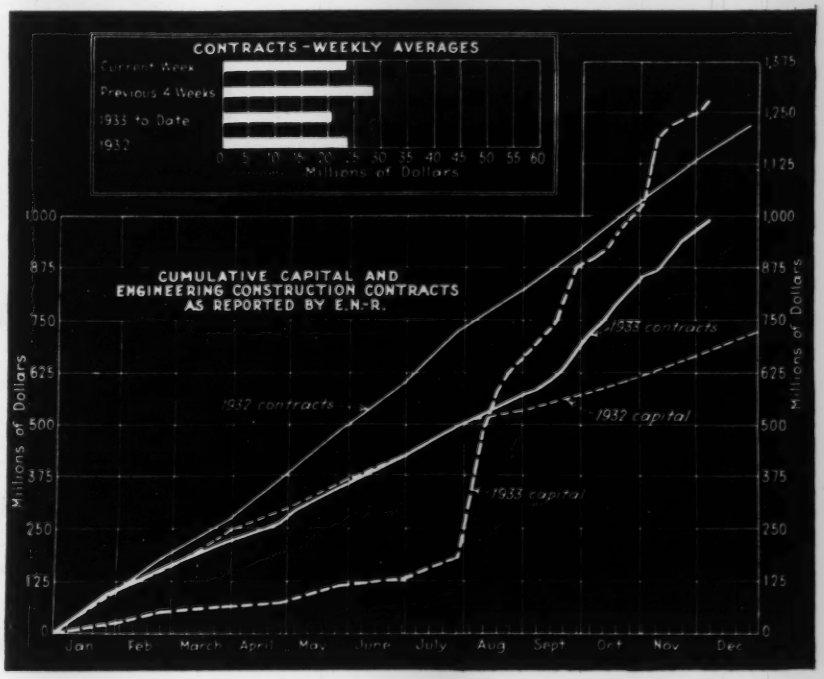
NEW PRODUCTIVE CAPITAL
(Thousands of Dollars)

	Week Dec. 7, 1933	Cumulative 1933
State and municipal	$ 165	$272,365
PWA allotments, public	24,648	770,219
Corporate issues	95	50,480
PWA allotments, private	1,310	187,058
Total new capital	$26,298	$1,280,292
Cumulative, 1932		$677,250

Note: These figures include private bonds and stock sold for productive purposes; state and municipal bonds for construction; R.F.C. advances for self-liquidating loans; PWA loans and grants to states and municipalities, including the special highway funds; and PWA private loans.

INDEX NUMBERS

E.N.-R.-Cost		E.N.-R.-Volume	
December, 1933	**192.14**	**November, 1933**	**133**
November, 1933	190.14	October, 1933	162
December, 1932	158.46	November, 1932	137
1932 (Average)	156.97	1932 (Average)	127
1931 (Average)	181.35	1931 (Average)	220
1930 (Average)	202.35	1930 (Average)	260
1913 (Average)	100		


CONTRACTS - WEEKLY AVERAGES
Current Week
Previous 4 Weeks
1933 to Date
1932
0 5 10 15 20 25 30 35 40 45 50 55 60
Millions of Dollars
CUMULATIVE CAPITAL AND ENGINEERING CONSTRUCTION CONTRACTS AS REPORTED BY E.N.-R.
1933 contracts
1932 contracts
1932 capital
1933 capital
Millions of Dollars
0 125 250 375 500 625 750 875 1000 1125 1250 1375
Jan Feb March April May June July Aug Sept Oct Nov Dec

Business Side of Construction

November Road Awards Heavy; Other Contracts Remain High

HEAVY ENGINEERING construction contracts reported in November (five weeks) totalled $147,446,000, or an average of 29.6 millions per week. The November average is second only to the October record of 35.4 millions in being the highest of the year. Highway lettings averaging $11,000,000 per week topped the October average and stands the highest in volume of contracts awarded for this class of work since September, 1932. The greatest loss over the previous month's figures was in federal contracts, which dropped from an average of 15.2 millions per week in October to 10.6 millions in November. The decline in federal construction accounted for the entire loss in public works awards over the October volume, this class falling from 29.7 millions per week to 24.8 millions. State and municipal awards remained practically the same as for the previous month, 14.2 millions. Since reaching the high point of the year in June, with 10.9 millions per week in contracts, private construction has steadily declined, except for a momentary rise in September, with the November awards standing at an average of 4.7 millions per week. This represents a loss of exactly a million dollars a week from the October total. Industrial building awards were the lowest of the year in November, but commercial building contracts were double those of October. Public building contracts, which have been practically non-existent for the entire year, came back strong with an average of 4.4 millions per week. Thes are nearly all federal projects, as very litt state and municipal work in the publi building field has been awarded this yea River and harbor contracts, which mad such a notable showing in October, fell t an average of 5.4 millions, or less than hal the previous month's average.

Materials notes

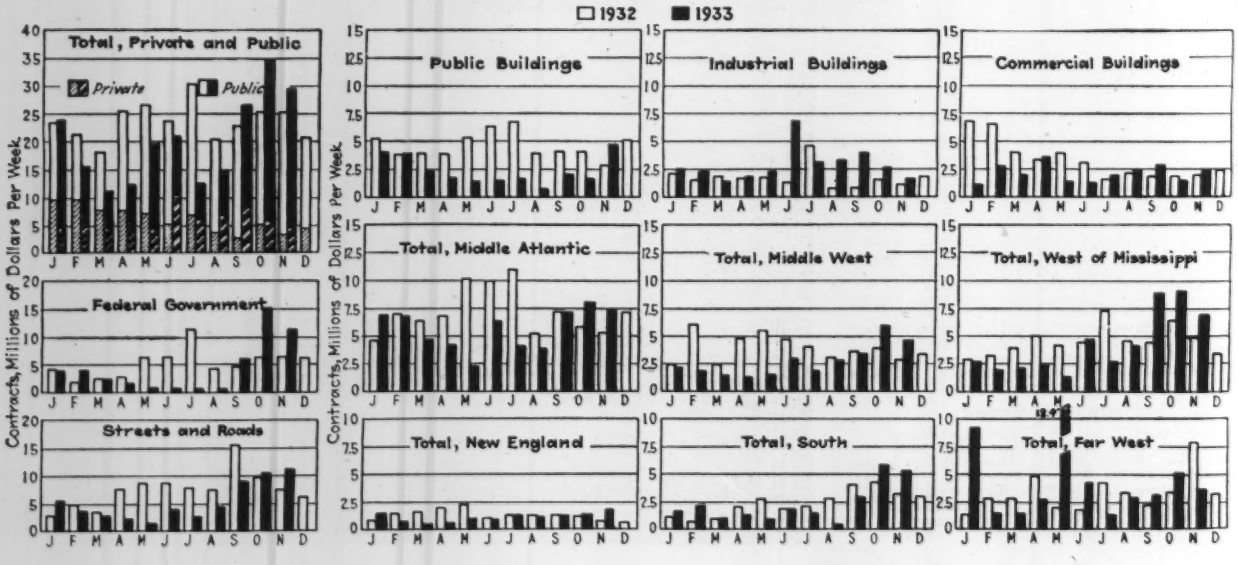
As the various codes became effective prices of construction materials steadied considerably over the confusion and un certainty prevailing for the past thre months. After weeks of confusion in th lumber market prices have been steadied to a point where quotations from most centers are those of the minimum price agreement set up in the lumber code. In many trading centers this represents a considerable drop in quotations over those published a month ago in the face of uncertainty. The only advance in major construction materials over the prices reported a month ago is in cast iron pipe, which advanced $5 a ton in the Eastern section and $4 a ton in the Mid-west and Western section of the country. Cement prices remained stationary except for an increase of 15c. a barrel reported by mills in Tennessee.

ENGINEERING CONSTRUCTION CONTRACTS REPORTED IN NOVEMBER, 1933

Five Weeks—Thousands of Dollars (000 omitted)

	New England	Middle Atlantic	South	Middle West	West of Mississippi	Far West	United States Nov. 1933	United States Eleven Months 1933	United States Eleven Months 1932	Canada Nov. 1933
Public Works										
Waterworks	480	683	151	162	730	731	2,937	65,814	25,402	2,412
Sewers	74	638	1,279	1,083	552	17	3,643	17,837	23,361	599
Bridges, public	1,820	2,488	514	999	2,040	160	8,021	76,340	73,416	.....
Earthwork and waterways	400	2,063	5,917	6,650	10,173	1,684	26,887	125,958	93,955	.....
Streets and roads	3,979	10,366	10,112	9,049	14,434	7,044	54,984	251,314	350,133	1,838
Buildings, public	1,397	5,185	6,202	798	5,007	5,497	24,086	111,716	214,867	.....
Unclassified, public	332	621	761	194	287	1,317	3,512	20,665	36,855	149
Total public	8,482	22,044	24,936	18,935	33,223	16,450	124,070	669,644	818,289	4,998
Federal gov't (included in other classifications)	2,681	5,337	13,384	6,977	15,489	8,916	52,784	198,089	240,393	.....
Private										
Bridges, private	.....	279	.....	.....	.....	.....	279	12,483	4,130	.....
Buildings, industrial	895	3,559	350	1,373	375	1,295	7,847	141,401	83,507	585
Buildings, commercial	130	9,955	.....	1,983	.....	399	12,467	96,897	154,337	500
Unclassified, private	153	1,150	489	362	596	53	2,783	45,381	55,986	.....
Total private	1,178	14,923	839	3,718	971	1,747	23,376	296,162	297,660	1,085
November, 1933 (5 weeks)	**9,660**	**36,967**	**25,775**	**22,653**	**34,194**	**18,197**	**147,446**	.....	.....	**6,083**
October, 1933 (4 weeks)	5,920	32,245	23,217	23,554	36,410	20,276	141,622	.....	.....	6,532
November, 1932 (4 weeks)	3,317	21,765	13,180	11,328	19,116	31,737	100,443	.....	.....	4,932
Eleven months, 1933	53,522	268,133	108,636	131,983	203,450	200,082	.....	965,806	.....	32,936
Eleven months, 1932	68,756	367,683	112,803	188,403	219,278	159,026	.....	.....	1,115,949	43,645

CONTRACTS REPORTED - WEEKLY AVERAGES - 1932-1933



Steel—The steady decline in the output of steel which has prevailed since July, when the industry was rated as operating at 59 per cent of capacity, occurred in November after the output had reached a low point of about 25 per cent. Operations at the close of the month were estimated at 28 per cent. The American Iron & Steel Institute estimates a total output of 2,111,842 tons of steel in October, which is 37.4 per cent of capacity of the industry. The average for the first ten months of this year is 34.7 per cent of capacity, as compared with 20.3 per cent for the same period last year. The American Institute of Steel Construction reports a loss of fabricated structural steel bookings in October as compared with the third quarter average, but showed an increase in shipping for the month. Shipments of fabricated steel in October totalled 72,913 tons. The decline in bookings is attributed to the delay in the public works program reaching a stage where orders for materials are forthcoming. Satisfactory operation of the steel code during the three months' trial period has resulted in extending the code to the first of June next. Although the code prohibits quotations for delivery more than three months in advance, exceptions have been made in permitting steel producers to accept orders for rails and for products for use in public works projects that call for delivery beyond a single quarter.

Cement—The portland cement industry in October, 1933, produced 5,037,000 bbl., shipped 6,750,000 from the mills, and had in stock at the end of the month 19,503,000 bbl., according to the Bureau of Mines. Production in October showed a decrease of 36.6 per cent and shipments a decrease of 22.8 per cent as compared with October, 1932. Stocks at the mills were 14.2 per cent higher than a year ago. Production of cement in October was rated at 24.5 per cent of capacity of the industry, as compared with 29.6 per cent a year ago, and 25.5 per cent the preceding month.

Lumber—The establishment of minimum prices in the lumber industry under provisions of the lumber code brought a rush of orders commencing the middle of November, checking a decline in business that had been steady for several months. Orders are now the greatest since May, 1930, according to reports of the National Lumber Manufacturers' Association. Unfilled orders on hand November 18 were the equivalent of 21 days' average production of mills, compared with 15 days' two weeks ago and 14 days' a year ago. Revised figures of lumber production in 1932 by the U. S. Census Bureau show a total output of 10,151,217,000 ft. which compares with 16,522,644,000 ft. in 1931 and 36,886,032,000 ft. in 1929.

Labor and employment

Construction employment enjoyed the greatest increase in years with the advent of the civil works program. According to figures from Washington, approximately 3,000,000 men have been returned to employment directly and indirectly on public works, including 1,183,000 employed by the civil works administration. From the period October 5 to November 25, the cumulative increase of employment on public works is estimated at 195 per cent. According to the American Federation of Labor, unemployment, which usually increases at this season, has been held close to the September level. The Federation unemployment estimates shows 10,076,000 out of work in October as compared to 10,065,000 in September, and trade union reports for the first part of November shows only a small increase in unemployment over October.

Tennessee Valley—Tennessee Valley authorities report that 1,200 men are employed on the Norris Dam. Hundreds of others are working at Muscle Shoals and headquarters in Knoxville and Washington. Plans contemplate bringing 3,000 additional members of the CCC into the Norris Dam area.

Highway Employment—Estimates place the number of men working on PWA highways the last of November at 128,653. At this time contracts in all states were reported at 36.3 per cent of allotments and work advertised for contracts as 47.7 per cent.

River Work—The chief of Army Engineers estimates that 38,000 men are at work under the river and harbor projects financed by PWA. These men are in addition to the 33,000 employed regularly on government work of this nature.

Chicago—Allotment of $8,000,000 by the PWA to the sanitary district in Chicago will put 4,000 men to work on the resumption of construction work abandoned two years ago for lack of funds. About 2,000 more will be given employment within the next three weeks.

Maryland—Large increases of both employment and combined payrolls and general contracting work in Maryland as a whole and in the Baltimore industrial area took place in October as compared with the previous months. Building construction, however, showed a decrease.

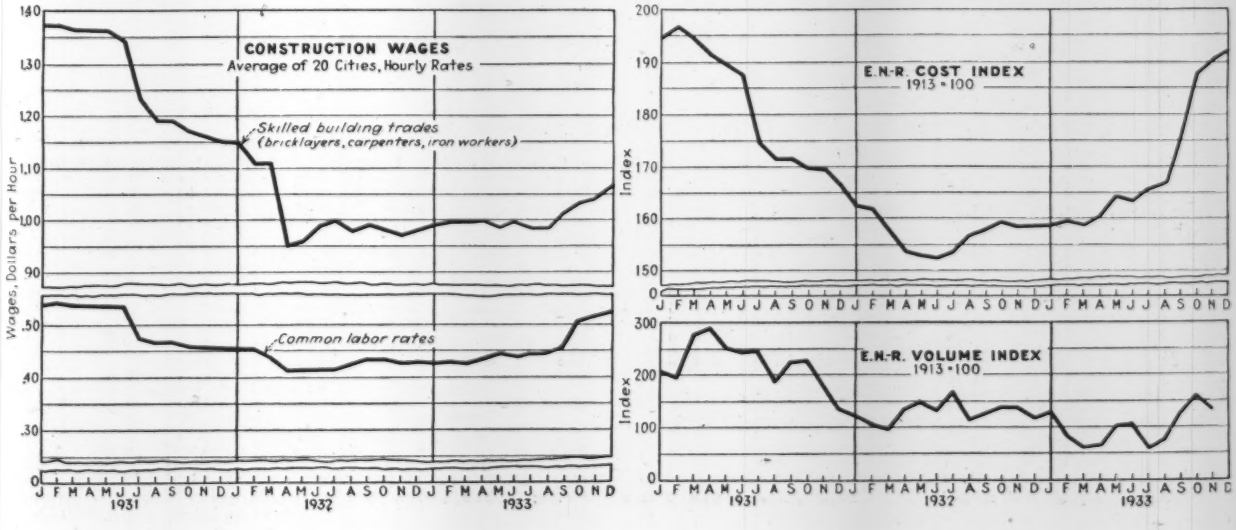
St. Louis—An ordinance passed by the St. Louis Council provides for a 30-day week and the paying of prevailing union scale of wages on all municipal improvements, contracted for by the city. The bill does not affect employees regularly employed by the city, but only those workers hired by contractors doing public construction work. The ordinance becomes effective on December 8.

E.N.-R. Cost and Volume Index

Rising labor costs again raise the *Engineering News-Record* Construction Cost Index for the six successive months. The index for December stands at 192.4, an increase of exactly 2 points over the November index. The average of common labor rates as used in the compilation of the index rose from 51.02 cents in November to 52.02 cents in December. At the same time the average of skilled wages in the country, though not used in the compilation of the cost index, rose to an average of $1.016. The three basic commodities of steel, lumber and cement, used in the compilation of the index, showed no change for the month. The rising cost index and the decline of construction volume for November dropped the *Engineering News-Record's* Construction Volume Index from 162 in October, the highest of the year, to 133 for November. This compares with 137 for November, 1932, and an average of 127 for the year 1932.

INDEX NUMBERS

E.N.-R.-Cost		E.N.-R.-Volume	
December, 1933	**192.14**	**November, 1933**	**133**
November, 1933	190.14	October, 1933	162
December, 1932	158.46	November, 1932	137
1932 (Average)	156.97	1932 (Average)	127
1931 (Average)	181.35	1931 (Average)	220
1930 (Average)	202.35	1930 (Average)	260
		1913 (Average)	100



Current Prices of Construction Materials

Cement, Aggregates and Ready-mixed Concrete

	PORTLAND CEMENT — Per bbl., carload lots, f.o.b. city, including cost of bags			SAND AND GRAVEL — Per ton, carload lots, f.o.b. city			CRUSHED STONE — Per ton, carload lots, f.o.b. city		CRUSHED SLAG — Per ton, carload lots, f.o.b. plant		CONCRETE — Ready Mixed 1:2:4, 50c.y. or more, delivered
	Cloth Bags*	Paper Bags	Bulk	Gravel, 1½ in.	Gravel, ¾ in.	Sand	1½ in.	¾ in.	1½ in.	¾ in.	
Atlanta	$2.92	$2.67	$2.67	$1.90	$1.90	$1.45	$1.90	$1.90	$1.90	$1.90	$8.00
Baltimore	2.71	2.46	2.26	1.80‡	2.00‡	1.20‡	1.75‡	1.75‡	2.25	2.25	6.75
Birmingham	2.67	2.42	.....	3.00†‡	3.00‡†	2.40†‡	.....	.....	.80	.80	5.75
Boston	2.72	2.47	2.27	1.50	1.50	1.10	1.50	1.50	.....	.....	6.50
Chicago	2.85‡	2.60‡	2.00	2.50†	2.50†	2.25†	2.50†	2.50†	.....	.....	.....
Cincinnati	2.56	2.31	2.01	1.30	1.30	1.20	1.81	1.81	.....	.....	7.50
Cleveland	2.50	2.25	.....	.....	1.65	1.55	1.55	1.55	1.75	1.75	7.50
Dallas	2.45	2.20	1.95	1.40	1.40	1.65	1.80	1.90	.....	.....	6.50
Denver	2.85‡	.....	.....	1.85	.....	1.25	.....	.....	.....	.....	.....
Detroit	2.25	2.00	1.80	1.15	1.05	.85	.72	.72	.90	.90	5.75
Kansas City	2.90	2.65	2.20	.65	.65	.65	1.25	1.25	.....	.....	7.50
Los Angeles	2.90	2.65	.....	1.90	1.90	1.40	1.90	1.90	.....	.....	6.70
Minneapolis	2.85	.....	2.40	1.00	1.00	.25	1.00	1.00	.....	.....	7.00
Montreal	.....	1.70	.....	.....	1.50	1.35	.....	1.25	.....	.....	.....
New Orleans	2.52	2.27	2.27	1.70	1.70	1.40	.....	.....	.....	.....	7.75
New York	2.90‡	2.65‡	.....	1.50†	1.50†	1.00†	1.75†	1.85†	.....	.....	8.00
Philadelphia	2.55	2.30	.....	2.00‡	2.25‡	1.80‡	1.75‡	2.00‡	1.75‡	1.75‡	6.84
Pittsburgh	2.50	2.25	1.65	1.50‡	1.50‡	1.70‡	2.25‡	2.25‡	1.25	1.25	8.25
St. Louis	2.49	2.24	.....	1.95‡	1.50‡	1.65‡	1.05‡	1.05‡	.75§	.75§	7.20
San Francisco	2.37	2.17	1.87	1.75	1.75	1.75	1.65	1.65	.....	.....	7.00
Seattle	2.90	2.65	.....	1.50†	1.50†	1.50†	.....	.....	.....	.....	5.75

*Includes 40c. per bbl. for bags, 10c. allowed for each returnable bag. †Per cu. yd. ‡Delivered. §F.o.b. Granite City, Ill.

CURRENT MILL PRICES CEMENT TO DEALERS, CARLOAD LOTS, F.O.B. MILL

Charge for bags not included. For cloth bags, add 40c. per bbl.; 10c. refund allowed for each returnable bag; for paper bags add 15c. per bbl., not refundable.

	Bagged	Bulk		Bagged	Bulk		Bagged	Bulk
Alpena, Mich	$1.65	$1.60	Iola, Kans	$1.70	$1.65	Richard City, Tenn	$1.85	$1.80
Buffington, Ind	1.60	1.55	La Salle, Ill	1.60	1.55	Riverside, Calif	1.72	1.67
Dallas, Tex. (Inc. 5c. tax)	1.80	1.75	Limedale, Ind	1.60	1.55	Saginaw, Mich	1.65	1.60
Hannibal, Mo	1.60	1.55	Mason City, Ia	1.70	1.65	Steelton, Minn	1.80	1.75
Hudson, N. Y	1.75	1.70	Norfolk, Va	1.76	1.71	Universal, Pa	1.65	1.60
Independence, Kans	1.70	1.65	Northampton, Pa	1.65	1.60	Waco, Tex (Inc. 5c. Tax)	1.80	1.75
Ironton, Ohio	1.60	1.55	North Birmingham, Ala	1.75	1.70	Wyandotte, Mich	1.60	1.55

Structural Clay Building Tile, Brick and Lime

	STRUCTURAL CLAY TILE — PARTITION — Per M, lots of 2,000 pieces or over, delivered			STRUCTURAL CLAY TILE — LOAD BEARING — Per M, lots of 2,000 pieces or over, delivered			BRICK — Per M, in quantity, delivered		LIME — Per ton, in paper, carload lots, delivered		
	3x12x12 in.	4x12x12 in.	8x12x12 in.	8x12x12 in.	10x12x12 in.	12x12x12 in.	Common backing	Straight hard	Hydrated finishing	Common hydrated	Pulverized or lump
Atlanta	$75.00	$95.00	$160.00	$208.40	$243.20	$277.90	$10.00	$10.00	$17.50	$13.00	$13.00
Baltimore	60.00	62.50	125.00	132.00	190.00	230.00	13.00	14.00	16.00	12.00	18.00
Birmingham	.....	89.00	167.00	.....	219.00	250.00	10.00	.....	.....	.....	.....
Boston	77.50	97.50	182.70	194.00	239.00	273.00	13.50	16.50	19.00	15.00	17.65
Chicago	62.25	66.40	91.30	.....	.....	.....	9.20	10.20	18.00	18.00	16.00
Cincinnati	43.25	52.80	97.00	112.20	148.10	168.40	11.00	15.00	14.50	12.40	.....
Cleveland	45.00	48.00	90.00	117.00	136.50	156.00	16.00	16.00	18.00	16.00	2.50§
Dallas	82.75	90.00	163.50	196.00	195.75	233.00	.....	15.50	18.50	.....	1.85§
Denver	75.00	80.00	135.00	135.00	185.00	220.00	11.75	25.50	18.00	16.00	2.60§
Detroit	60.03	64.00	120.00	170.00	200.00	250.00	11.50	12.00	20.00	20.00	16.00
Kansas City	62.50	75.00	140.50	155.00	.....	.....	13.50	18.00	.55‡	.50‡	2.25§
Los Angeles	77.50	94.25	134.00*	188.00	232.50	311.50	11.50	.....	18.70	.....	19.70
Minneapolis	77.00	84.00	143.00	165.00	173.00	240.00	10.00	18.00	25.50	21.00	21.00
Montreal	.....	110.00	.....	.....	260.00	.....	19.00	32.00	20.00	16.00	16.00
New Orleans	58.40	62.30	116.90	159.20	194.60	.....	.....	13.00	23.00	12.50	1.95§
New York	81.00	86.00	129.00	193.30†	238.80†	295.60†	12.75	.....	19.00	15.00	20.00
Philadelphia	78.00	85.00	160.00	195.00	235.00	295.00	15.00	18.00	14.60	11.00	10.50
Pittsburgh	44.00	48.00	95.00	106.00	118.00	143.00	15.00	20.00	16.25	15.25	17.20
St. Louis	57.00	60.00	110.00	130.00	150.00	190.00	14.00	16.00	.55‡	.45‡	2.40§
San Francisco	68.00	76.50	174.00	.....	.....	.....	14.00	16.00	22.50	19.00	.....
Seattle	80.00	87.00	200.00	50.00	.....	.....	14.00	16.00	30.00	25.00	3.00§

*6x12x12 in. †F.o.b. Perth Amboy, N. J. ‡Per sack. §Per bbl.

Road Surfacing Materials

	PAVING BRICK AND BLOCKS — Granite Blocks per M, lots of 50,000, 4x8x4 in., f.o.b. city	Brick per M, 3x8½x4 in., carload lots f.o.b. city	Wood Blocks per sq.yd., 3½ in., 16-lb. treat, f.o.b. city	PAVING ASPHALT — Per ton, less than 80 penetration, f.o.b. city: Tank car	Drums	ASPHALT BINDERS — FLUXES — Per gal., 80-300 penetration, f.o.b. city: Tank car	Drums	CUTBACK ASPHALT — Per ton, f.o.b. city: Tank car	Drums	ROAD OILS — Per gal., f.o.b. city: Tank car	ASPHALT EMULSION — Per gal., f.o.b. city: Tank car	Drums
Atlanta	$3.00*	$35.00	$2.25	$18.20	$23.41	$0.0728	$0.989	$20.45	$27.22	$0.0728	$0.105	$0.105
Baltimore	135.00	43.00	2.00	17.00	22.00	.07	.095	.08†	.115†	.065	.....	.....
Birmingham	65.00	25.00	.....	11.00	.....	.....	.....	.....	.....	.....	.06	.....
Boston	65.00	32.00	2.00	14.00	18.00	.055	.09	.07†	.105†	.055	.09	.145
Chicago	3.80*	42.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Cincinnati	110.00	37.00	.....	15.00	20.00	.09	.....	15.00	.....	.075	.08	.....
Cleveland	125.00‡	37.50	.....	16.00	18.50	.085	.125	18.50	20.00	.048	.065	.10
Dallas	.....	.....	.....	11.85	16.85	.0948	.1448	15.00	21.00	.02	.08	.11
Detroit	.....	34.50	.....	14.29	16.88	.....	.....	13.94	17.94	.....	.....	.....
Kansas City	.....	28.00	2.75	12.00	17.00	.05	.09	.07	.11	.05	.05	.09
Los Angeles	.....	48.50	.....	12.00	16.00	12.00#	16.00#	14.00	.....	.042	.0525	.1125
Minneapolis	.....	.....	2.50	17.30	21.30	.065	.105	19.60	32.20	.048	.....	.....
Montreal	.....	100.00	.....	14.00	19.66	.07	.093	19.00	26.50	.07	125.00	.155
New Orleans	200.00	35.00	.....	13.00	18.00	.....	.....	.....	.....	.....	.....	.....
New York	135.00	47.50	2.05	17.00	22.00	.07	.095	.08†	.115†	.065	.085	.12
Philadelphia	115.00	45.00	2.02	11.00	17.00	.....	.....	.....	.....	.....	.....	.....
Pittsburgh	115.00	35.00	.....	19.00	24.00	.0775	.1125	.086†	.121†	.0675	.....	.....
St. Louis	2.80*	35.00	2.00	17.50	21.50	.0675	.....	.....	.....	.035	.095	.....
San Francisco	.....	45.00	.....	12.00	18.00	12.00#	18.00§	14.00#	21.50#	.04	.08	.12
Seattle	.....	47.50	.....	18.00	23.10	18.00	23.10	15.00	.....	.02	19.20#	34.20#

Note: Paving asphalt, tank car or boat, f.o.b. Maurer, N. J., per ton, Bermudez, $26.00; Trinidad, $22.00. *Per sq. yd. †Per gallon. ‡4½x6x5½in #Per ton

Current Prices of Construction Materials

Iron and Steel Products—Base Mill Prices

	STRUCT. SHAPES-PLATE Per 100 lb., carload lots	REINF. BARS Per 100 lb., ¾-in. billet, carload lots	RIVETS Per 100 lb., ½-in. structural carload lots	WIRE NAILS Per 100 lb., base, carload lots	SHEET PILING Per 100 lb., base, carload lots	STEEL RAILS Per Gross Ton: Standard	Light	Re-rolled	TRACK SUPPLIES Per 100 lb., carload lots: Angle bars	Std. spikes	Tie plates	Track bolts
Birmingham	$1.85	$2.00	.....	$2.10	.....	$36.375	$32.00	$31.00	$2.55	$2.40	$1.90	$3.50
Chicago	1.75	1.95	$2.60	2.10	$2.00	36.375	32.00	31.00	2.55	2.40	1.90	3.50
Pittsburgh	1.70	1.90	2.50	2.10	2.00	36.37[c]	32.00	.....	2.55	2.40	1.90	3.50

Iron and Steel Products—Local Prices f.o.b. Warehouse

	STRUCTURAL SHAPES Per 100 lb., base price	REINFORCING BARS Per 100 lb., ¾ in., base price: New billet	Rail steel	EXPANDED METAL LATH —Per 100 sq.yd., carload lots— Std. diamond mesh, 3.4 lb.	Std. ribbed 3.4 lb.	WELDED FABRIC REINFORCING —Per 100 s.f., carload lots— 4x16 in., No. 5 & 10 wires	4x12 in., No. 8 & 12 wires	6x6 in., No. 6 & 6 wires Per sq.yd.	SHEET PILING Per 100 lb. base price
Atlanta	$3.34	$2.17	$2.02	$19.50	$22.00	$1.60	$1.21	$0.151	$2.45
Baltimore	2.50	2.50	2.25	20.00	22.00	1.46	1.12	.137	2.25
Boston	3.42	2.82	2.35	20.25	24.25	1.50	1.14	.142	2.40
Chicago	3.60	2.43	.....	.....	.....	1.46	1.12	.137	2.00
Cincinnati	2.75	2.50	2.50	19.00	22.00	1.44	1.11	.135	.....
Cleveland	2.90	2.90	2.45	15.40	17.40	1.44	1.11	.135	.....
Dallas	4.00	3.50	3.45	21.00	22.00	1.79	1.27	.161	.....
Denver	3.29	3.54	.....	23.00	27.00	1.79	1.27	.161	.....
Detroit	3.30	2.985	2.85	15.00	19.00	1.48	1.13	.139	2.885
Kansas City	3.75	2.75	2.50	24.50	.....	1.54	1.17	.145	.....
Los Angeles	3.00	2.85	.....	25.00	30.00	2.00	1.40	.18	2.50
Minneapolis	3.15†	2.52†	2.37†	20.50†	23.00†	1.66	1.20	.149	2.40†
Montreal	3.25	3.00	2.80	.....	.....	.....	.....	.....	3.30
New Orleans	3.50	3.00	.....	19.50	23.00	1.58	1.20	.149	.....
New York	3.27	2.57	2.42	20.50	24.00	1.53	1.18	.139	.....
Philadelphia	2.60	3.00	.....	18.50	22.00	1.44	1.11	.135	2.28
Pittsburgh	1.70‡	1.80‡	1.75‡	17.00‡	22.00‡	1.44	1.11	.135	2.00‡
San Francisco	3.55	3.15	.....	21.50	24.50	1.90	1.40	.18	.....
Seattle	3.40	3.50	.....	.....	.....	1.90	1.40	.18	.....
St. Louis	3.34	2.29	2.14	18.50	21.50	1.46	1.12	.137	.....

†F.O.B. City. ‡Base Mill Price. Note: Shapes, bars and piling subject to quantity discounts.

Paints and Roofing Supplies

	WHITE LEAD Per 100 lb. keg in oil, f.o.b.	READY-MIXED PAINT Per gal., drums, f.o.b.: Graphite*	Aluminum†	Ferric Oxide‡	ROOFING SUPPLIES Carload lots, f.o.b. city: Rolls, slate surfaced, 85-90 lb., per sq.	Asphalt felt, per 100 lb.	Tar felt, per 100 lb.	Asphalt coating, per gal.	Tar pitch, 350-lb. bbl., per ton
Atlanta	$11.75	$1.50	$1.50	$1.50	$1.94	$3.02	$3.30	$0.37	$22.80
Baltimore	11.00	1.20	2.00	1.75	1.80	2.50	2.50	.50	25.00
Boston	11.00	1.05	1.80	1.50	1.85	2.50	2.50	.6625	23.00
Chicago	11.00	1.85	2.25	1.25	1.60	1.50[s]	1.50[s]	.24	20.00
Cincinnati	11.00	1.40	3.00	1.55	2.40	2.25[s]	2.25[s]	.36	25.00
Cleveland	11.00	1.65	2.35	.....	1.65	47.50[o]	47.50[o]	.33	19.50
Dallas	12.00	1.30	2.75	.....	1.98	.....	.....	.51	25.00
Denver	11.12½	.....	2.55	.....	2.75	3.46	3.46	.60	30.00
Detroit	11.00	1.55	2.40	1.30	1.59	2.31	2.50	.40	27.00
Kansas City	11.12½	.....	.....	.....	2.40	1.65	.....	.33	.....
Los Angeles	10.75	1.60	2.25	2.30	2.00	1.50	.....	.45	.....
Minneapolis	11.12½	.....	.....	.....	1.60	2.30	2.30	.2925	23.30
Montreal	9.75	.....	.....	.....	.....	2.62	2.02	1.40§	1.63§
New York	11.00	1.70	2.15	1.42	.....	.....	.....	.....	.....
Philadelphia	11.00	.....	.....	.....	1.60	1.50	1.50[s]	.29	20.00
Pittsburgh	11.00	1.05	1.95	.80	1.90	1.65[s]	1.65	.31	23.00
St. Louis	11.00	1.85	2.25	1.25	1.88	2.73	2.73	.44	26.00
San Francisco	10.75	.....	.....	.....	.....	.....	.....	.....	.....
Seattle	10.75	.....	1.92	.....	3.10	4.50	.....	.54	27.60

*New Jersey State Hwy. Spec. 120M. †ASTM Spec. D266-31. ‡80% maximum ferric oxide. °Per ton. §Per 100 lb. [s]Per roll.
Note: Red lead dry, same as white lead in oil, red lead in oil 50c higher.

Miscellaneous Items

WINDOW GLASS

Discounts from latest jobbers list, Sept. 15, 1928, for sizes above first three brackets Single or Double Thickness

	A quality	B quality
Atlanta	85%	85%
Baltimore	88%	90%
Birmingham	89%	91%
Boston	88%	90%
Chicago	87%	89%
Cincinnati	.....	.....
Cleveland	80%	85%
Dallas	.....	.....
Denver	84@ 5%	86@ 5%
Detroit	87@10%	89@10%
Kansas City	89@10%	89@10%
Los Angeles	90%*	90@40%*
Minneapolis	84%	86%
Montreal	.....	.....
New Orleans	87@10%	90@10%
New York	87%	89%
Philadelphia	88@10%	90@10%
Pittsburgh	86%	88%
St. Louis	87%	89%
San Francisco	.....	.....
Seattle	90@10%	90@20%

*Disc. from list Aug. 1, 1929. †F.o.b. Arsenal.

EXPLOSIVES

Per lb dynamite delivered 50-lb. cases Gelatin

	40%	60%
Atlanta	$0.215	$0.2375
Baltimore	.18	.195
Birmingham	.15	.1725
Boston	.2225	.2375
Chicago	.17	.195
Cincinnati	.22	.245
Cleveland	.1825	.1975
Dallas	.24	.28
Denver	.19	.205
Detroit	.237	.255
Kansas City	.16	.18
Los Angeles	.1725†	.1925†
Minneapolis	.1725	.1875
Montreal	.1675	.1925
New Orleans	.19	.22
New York	.23	.245
Philadelphia	.215	.24
Pittsburgh	.1175	.1325
St. Louis	.1375	.1525
San Francisco	.1575	.1725
Seattle	.1525	.1675

CHEMICALS

Water, sewage treatment, road work, f.o.b., carlots, New York:	
Bleaching powder, in drums, f.o.b. works, per 100 lb	$1.90
Calcium chloride, 77-80%, flaked, in 400-lb. drums or 100-lb. moisture proof bags, f.o.b. works, freight equalized with points of competition, per ton	19.50
Chlorine, cylinders, per lb. delivered	.05½
Silicate of soda, 60 deg., in drums, f.o.b. works, per 100 lb	1.65
Soda ash, 58%, in bags, per 100 lb	1.17½
Sulphate of aluminum, in 100 lb. bags	1.25
Sulphate of copper, in bbl., per 100 lb	3.75

PILES

Prices of Nichols Bros., 90 West St., N. Y. C., per linear foot, pine, with bark on, f.o.b., New York; delivered from barge, 1½ to 2c, per ft. additional:

Dimensions	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.09	$0.145
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	.13	.195
12 in.—2 ft from butt	6 in.	60 to 69 ft.	.15	.215
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	.185	.225
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	.2025	.225
14 in.—2 ft. from butt	5 in.	80 to 85 ft.	.265	.375
14 in.—2 ft. from butt	5 in.	85 to 89 ft.	.305	.442

RAILWAY TIES

Prices f.o.b., per tie, for carload lots:		6 In. x 8 In. by 8 Ft.	7 In. x 9 In. by 8½ Ft.
Boston	Oak, untreated	$0.90	$1.20
	Pine, untreated	.90	1.20
	Pine, creosoted	1.35	1.85
New York	Long-leaf sap pine, untreated	.80	1.00
	Mixed oak, untreated	.....	1.00
	White oak, untreated	.75	1.50
Birmingham	White oak, creosoted	1.40	1.45
	Southern pine, untreated	.35	.60
	Southern pine, creosoted	.95	1.35
Chicago	White oak, untreated	1.15	1.35
	Oak, empty cell, creosoted	1.50	1.80
	Oak, zinc treated	1.40	1.65
	Southern pine, creosoted	1.35	1.50
Los Angeles	Fir, untreated	.64	.89
	Fir, creosoted	1.84	2.59
Philadelphia	Red oak, untreated	1.00	1.20
	Red oak, creosoted	1.50	1.85
	White oak, untreated	1.00	1.45
St. Louis	Red oak, untreated	.90	1.35
	Red oak, creosoted	1.30	1.85
San Francisco	Sap Pine or cypress, untreated	.80	1.15
	Douglas fir, green, untreated	.45	.63
	Douglas fir, empty cell, creosoted	1.14	1.56
Montreal	Birch or maple, untreated	1.00	1.00
	Birch or maple, creosoted	1.25	1.55

Current Prices of Construction Materials

Water, Sewer and Drain Pipe

	C. I. PIPE Per net ton, f.o.b. 6 in. and over b. & s. class B and heavier, C/L lots*	VITRIFIED SEWER PIPE Per foot, delivered, standard 8 in., s.s.	12 in., s.s.	24 in., d.s.	36 in., d.s.	CLAY DRAIN TILE Per 1,000 ft., carload lots, f.o.b. 6 in.	8 in.	CONC. SEWER PIPE Per ft., delivered; ASTM Spec. C 14-24 12 in.	24 in.	WROUGHT STEEL PIPE Full std. weight. Discounts from standard list for delivery from warehouse, except Pittsburgh prices are f.o.b. mill. Base price $200 per net ton. List prices per ft.: ¼ in., 9c; ⅜ in., 12c.; 1 in., 17½c.; 2 in., 37½c.; 2½ in., 59c.; 3 in., 77c.; 4 in., $1.10; 6 in., $1.94. 1 to 3 in., Butt Weld Black	Galv.	2½ to 6 in., Lap Weld Black	Galv.
Atlanta	$40.00	$0.225	$0.405	$1.4625	$3.25	$80.00	$128.00	$0.625	$1.625	52%	44.5%	50%	42%
Baltimore	43.50	.28	.50	2.25	4.50	85.00	150.00	.50	1.50	.....	.....	.....	.....
Birmingham	36.00	.30	.54	1.95	5.00	.....	.....	.....	.....	.....	.....	.....	.....
Boston	45.50	.29	.56	2.91	7.45	60.10	101.00	.45	2.00	55.59%	44.83%	56.85%	46.10%
Chicago	44.00	.35	.675	2.25	5.125	120.00	.....	.675	2.25	.....	.....	.....	.....
Cincinnati	43.00	.224	.432	1.71	5.2275	90.00	.....	.38	1.30	57.33%	46.31%	58.55%	47.53%
Cleveland	44.50	.329	.6345	2.61	7.175	42.50	88.50	.536	2.102	59.4%	48.4%	60.6%	49.6%
Dallas	48.00	.30	.54	2.15	.....	99.00	.....	.....	.....	.....	.....	.....	.....
Denver	56.00	.23‡	.415‡	1.73‡	.....	100.50‡	.....	.....	.....	.....	.....	.....	.....
Detroit	44.50	.28	.54	2.25	.....	100.00	150.00	.....	.....	.....	.....	.....	.....
Kansas City	46.00	.33	.52	1.90	3.80	120.00	180.00	.....	.....	.....	.....	.....	.....
Los Angeles	44.50	.2825‡	.508‡	2.03‡	5.535‡	115.50	192.50	1.00	2.00	.....	.....	.....	.....
Minneapolis	46.50	.215‡	.387‡	1.548‡	4.35‡	64.90	120.00	.....	.....	53%	42%	54%	43%
Montreal	.....	.....	1.02	3.64	.....	.....	.....	.....	.....	.....	.....	.....	.....
New Orleans	42.00	.28	.392	1.90	.....	45.00	.....	.45	1.65	.....	.....	.....	.....
New York	43.00	.35	.675	2.83	7.48	.....	.....	.50	2.00	56.164%	45.144%	57.389%†	46.368%†
Philadelphia	41.50	.126	.243	1.17	4.615	.....	.....	.....	.....	56.65%	45.63%	57.88%	46.86%
Pittsburgh	46.00	.175‡	.3375‡	1.53‡	4.8175‡	46.00	82.00	.75	1.75	67.5%	58.5%	68.5%†	59.5%†
St. Louis	43.00	.26	.468	2.85	3.96	85.00	195.00	.45	1.55	55.796%	44.76%	57.021%	46.0%
San Francisco	44.00	.25	.45	1.80	4.50	112.00	.....	.....	.....	.....	.....	.....	.....
Seattle	45.50	.35	.63	2.52	.....	84.00	175.00	.50	1.60	60.3%	51.3%	63.3%	52.3%
Burlington, N. J. (base)	40.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

*Gas pipe and class A, $3 per ton additional, 4-in., $3 per ton additional. †3½ to 6 in. ‡f.o.b.

Lumber and Timber

SHORT LEAF YELLOW PINE AND DOUGLAS FIR — Per M ft. b.m., carload lots f.o.b. All S. L. Y. P. is No. 2 common or better and for No. 1 N. C. Box. All Fir planks No. 2 common; Fir timber is No. 1 common. S. L. Y. P. lumber is 10 to 20 ft. Fir lumber is up to 20 ft.

LONG LEAF Y. P. — Per M ft. b.m., carload lots, f.o.b., merchantable grade up to 20 ft.

		1x6, S4S	1x8, S4S	2x4, S4S	2x6, S4S	2x8, S4S	2x10 S4S	3x12 Rgh	6x12 Rgh.	12x12, Rgh.	2x12, Rgh.	12x12, Rgh.
Atlanta	Southern Pine	$20.00	$21.00	$23.00	$20.00	$21.50	$22.00	$30.00	.....	.....	48.00	$47.00
Baltimore	Southern Pine	26.00	26.50	24.50	24.50	26.00	29.00	31.00	.....	.....	60.00	58.00
	Douglas Fir	25.50	27.00	26.50	26.50	27.00	27.00	33.50	$31.50	$30.50	.....	.....
Birmingham	Southern Pine	40.00	40.00	.....	.....	.....	.....	50.00	.....	55.00	.....	.....
Boston	Southern Pine	32.00	32.00	38.00†	38.00†	62.00‡	67.00‡	70.00‡	.....	.....	72.00	72.00
	Douglas Fir	31.00	31.00	35.00	35.00	37.00	39.00	42.00	42.00	42.00	.....	.....
Chicago	Southern Pine	34.00	35.00	33.00	32.	33.00	34.00	49.00	65.00	65.00	54.00	54.00
	Douglas Fir	40.00	42.00	40.00	40.00	40.00	42.00	50.00	50.00	50.00	.....	.....
Cincinnati	Southern Pine	37.00	37.00	30.00	30.00	30.00	33.00	40.00	.....	.....	.....	.....
	Douglas Fir	.....	.....	.....	.....	.....	.....	47.50	47.50	50.00	.....	.....
Cleveland	Southern Pine	30.50	31.50	37.50	35.50	36.50	38.00	46.75	.....	.....	36.75	56.75
	Douglas Fir	.....	.....	36.75	.....	.....	.....	.....	44.25	.....	.....	.....
Dallas	Southern Pine	28.00	29.00	33.50	31.00	33.50	32.75	47.50	.....	.....	52.50	60.00
	Douglas Fir	32.50	30.00	36.50	34.00	36.50	41.50	52.50	55.00	55.00	.....	.....
Denver	Douglas Fir	38.00*	40.00*	40.00*	40.00*	40.00*	41.00*	51.00*	58.00*	.....	.....	.....
Detroit	Southern Pine	29.00	30.00	32.00	29.00	31.00	32.00	36.00	.....	.....	33.00	45.00
	Douglas Fir	.....	.....	.....	.....	.....	.....	44.00	45.00	47.00	.....	.....
Los Angeles	Douglas Fir	27.00	27.00	27.00	27.00	27.00	30.00	27.00	31.00	28.00	.....	.....
Minneapolis	Western Pine	47.00	47.00	41.00	41.00	41.00	39.00	47.50	.....	.....	.....	.....
	Douglas Fir	34.50	34.50	34.50	34.50	34.50	39.00	44.50	44.50	42.50	49.50	49.50
Montreal	Spruce	27.00	29.00	21.00	23.00	24.50	31.50	34.50	.....	.....	.....	.....
	Douglas Fir	48.00	51.00	45.00	50.00	53.00	62.00	.....	.....	.....	.....	.....
New Orleans	Southern Pine	18.00	19.00	.....	.....	.....	.....	30.00	.....	.....	.....	.....
	Douglas Fir	21.00	21.00	.....	.....	.....	.....	42.50	.....	.....	.....	.....
New York	Southern Pine	33.00	34.00	35.00	35.00	35.00	37.00	36.00	.....	.....	75.00	75.00
	Douglas Fir	.....	.....	38.00	36.00	37.00	37.00	36.00	40.00	40.00	.....	.....
Philadelphia	Southern Pine	29.00	30.00	28.50	28.00	29.00	31.00	34.00	.....	.....	64.00	64.00
	Douglas Fir	.....	.....	34.50	34.50	35.00	35.00	37.50	40.00	40.00	.....	.....
Pittsburgh	Southern Pine	26.50	27.75	32.75	29.25	31.75	32.75	41.50	.....	.....	57.50	57.50
	Douglas Fir	33.50	34.50	34.50	33.50	34.00	34.25	46.25	46.25	46.25	.....	.....
St. Louis	Southern Pine	33.00*	36.00*	33.00*	31.00*	33.50*	40.00*	49.00*	.....	.....	55.00*	61.00*
	Douglas Fir	.....	.....	.....	.....	.....	.....	59.00*	59.00*	59.00*	.....	.....
San Francisco	Douglas Fir	28.00	28.00	28.00	28.00	28.00	30.00	29.00	31.00	31.00	.....	.....
Seattle	Douglas Fir	22.50	21.50	21.50	21.00	22.00	22.50	20.00	20.00	22.00	.....	.....

*Delivered. †Spruce. ‡Long-leafed Y. P.

Current Building and Construction Wage Rates Per Hour

	Bricklayers	Carpenters	Structural Iron Workers	Hoisting Engineers	Plasterers	Common Labor Building	Common Labor Heavy Const
Atlanta	$0.75/1.125	$0.40/.90	$0.60/1.25	$0.60/1.25	$0.50/.75	$0.30/.40	$0.30/.40
Baltimore	1.10	.75	1.00	1.00	1.10	.30	.30
Birmingham	.75/.87½	.60	.75	.75	.....	.25/.30	.25/.30
Boston	.90/1.30	.70/1.17½	1.20	.90/1.17½	.90/1.62½	.40/.70	.40/.70
Cincinnati	1.27½	1.02½	1.20	1.07½	1.27½	.45	.40
Chicago	1.50	1.31¼	1.35	1.31¼	1.50	.82½	.82½
Cleveland	1.25	1.12½	1.25	1.125	1.25	.72	.72
Dallas	1.12½	.875	1.00	1.00	1.125	.40	.40
Denver	.60/1.12½	.60/.87½	.60/.87½	.60/.87½	.....	.50	.50
Detroit	1.25	.75/1.25	1.00	.70/90	1.25	.50	.50
Kansas City	1.32½	1.12½	1.12½	1.12½	1.32½	.70	.50/.60
Los Angeles	.90	.75	1.12½	.75	.90	.45	.60
Minneapolis	1.25	.75	.90	.75	.90	.40	.50
New Orleans	1.00	.75	1.00	1.00	1.25	.30/.40	.30/.40
New York	1.50/1.65	1.25/1.40	1.65	1.50/1.65	1.50	.93½	.62½/.82½
Philadelphia	.75/1.50	.50/1.00	1.00/1.37½	.75/1.67	.75/1.37½	.30/40	.30/.40
Pittsburgh	.50/1.50	.50/1.25	.50/1.37½	.50/1.37½	.50/1.25	.35/.70	.35/.70
St. Louis	1.50	1.25	1.47	1.35/1.47	1.50	.78½	.35/.78½
San Francisco	1.12½	.90	1.20	1.00	1.10	.60	.60
Seattle	1.20	.90	1.10	1.00	1.20	.60	.60
Montreal	1.20	.55	.85	.85	.85	.30	.20

Skilled Ave: (Bricklayers, Carp., Ironworkers) $1.062. Common Ave. $0.5202